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ABSTRACT

This study determined how children develop reading ability in first and second grade. Subjects, approximately 315 children from 3 school districts in the midwest, were given a series of standardized and customized measures of reading comprehension. Linear structural models were developed at both grade levels using LISREL to explain variance in students' reading development. Results indicated: (1) interplay between first-grade entry-level student performance and teachers' classroom activities; (2) first-grade classroom activities were found to affect some behaviors at home; (3) second-grade teachers continued to be affected by students' entering abilities; (4) teachers' behaviors, unfortunately, were also found to be related to students' home backgrounds; and (5) home support activities were not found to be influenced by home background as they had been in the earlier grades. (Nine tables of data and five figures representing various models of development of reading ability are included; 72 references are attached.) (RS)

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CENTER FOR THE STUDY OF READING

Technical Report No. 516

THE DEVELOPMENT OF READING ABILITY IN FIRST AND SECOND GRADE

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October 1990

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Abstract

A study was conducted to determine how children develop reading ability in first and second grade. Approximately 315 children from three school districts in the midwest participated. The study began with the development of a heuristic model that guided data collection on measures of entering student ability, home background, home support, classroom instructional processes, and student performance at the end of each grade level. Linear structural models were developed at both grade levels using LISREL to explain variance in students' reading development. As expected, the study found a relationship between entering ability and achievement at the end of each grade level. At the first-grade level, interplay was found between entry-level student performance and teachers' classroom activities. In addition, classroom activities were found to affect some behaviors at home. Once students brought schoolwork home, parents worked with them on it. At the second-grade level, it was found that teachers continued to be affected by students' entering abilities. Teachers gave more sustained feedback to lower performers, and they emphasized letter sounds and background knowledge interactions with these same students, although these behaviors did not show a relationship to students' end-of-year performance. Teachers' behaviors, unfortunately, were also found to be related to students' home backgrounds. In addition, home support activities were not found to be influenced by home background as they had been in the earlier grades. The results are discussed in terms of eight issues that became clear in the examination of both the first- and second-grade findings. Three of these issues are (a) the diminished effects of home background, (b) positive effects for seatwork, and (c) students' abilities as influences on teachers' instructional practices.

THE DEVELOPMENT OF READING ABILITY IN FIRST AND SECOND GRADE

The purpose of this report is to present findings from a study of how children learn to read in first and second grades. It is part of a longitudinal research project that is investigating how children develop reading comprehension ability and science knowledge in kindergarten through sixth grade.

We know of no research comparable to this work in either its length or breadth, although a few studies of learning, drawn primarily from cognitive psychology, classroom instruction, and the fairly general results from longitudinal studies of reading development, are generally related because they have examined some aspects of children's development either experimentally or naturalistically. Although these studies are somewhat peripheral to the primary question driving our research, that is, how children develop the ability to comprehend what they read over time, they represent the many diverse areas of research on reading development that form the spectrum of knowledge in the field of reading research, the constellation from which we developed first our heuristic and then our measurement models. For that reason, we believe a brief review of this research would be valuable.

Findings from Cognitive Psychology

Studies with results demonstrating positive relationships between early letter-sound and word knowledge, and decoding speed, and later reading comprehension ability have a certain utility for program development and evaluation, but these results do not lead to understanding the cognitive processes children develop as they learn to comprehend what they read. However, recent research by cognitive psychologists on what experts do when they read and on how reading comprehension is affected by what readers know and how they monitor themselves to be certain they are comprehending, illustrates that we have made substantial progress toward understanding basic processes of reading comprehension.

What experts do when they read. Schemata are the mental models of knowledge in various areas that readers bring to each new situation. How do human beings develop schemata? Researchers have tried to answer this question with numerous cross-sectional studies that compare experts in a particular field with non-experts (see, for example, Chase & Simon, 1973; de Groot, 1966). The primary conclusion from these studies is that "exposure and practice are the major variables" (Bransford, Nitsch, & Franks, 1977, p. 35). In other words, experts simply have had more opportunities to learn about their areas of expertise, and they have had extended opportunities for practice that govern their overall functioning. But these studies of experts stop short of explaining *how* people continue to "gain skill, clarity, and understanding rather than concentrate on the knowledge they have already attained" (Bransford, Nitsch, & Franks, 1977, p. 32). This issue is central to our study.

Lesgold (1983) addressed the issue by focusing on instructional research to explain how students progress from one stage of knowledge, or expertise, to another. Therefore, Lesgold's questions were quite different from those of researchers comparing adult experts and novices. His conclusions and implications for instruction converge on (a) the importance of corrective feedback, (b) the need for component procedures to be automated so that a student can concentrate on the specific issue in question, (c) the creation of an overt plan for solving the problem, (d) sequential "rule" teaching that moves from the simple to the complex, and (e) inclusion of drills, as necessary, to develop automated skills even though the drills might not be "target performances."

The effects of background knowledge. Many studies in the last decade have demonstrated that comprehension ability is greatly affected by what the reader knows about the topic she or he is reading. These investigations have their roots in the theoretical work by Bartlett (1932), who used the word schema to describe "an active organization of past reactions, or experiences" (p. 201). More recently, Ausubel, Novak, and Hanesian (1978) produced a series of publications focused on learning theory and

retention. The common theme in their work is that "new meanings are acquired by the interaction of new knowledge with previously learned concepts or propositions" (p. 127).

Several exemplary studies, most notably those by Anderson (1977, 1978); Anderson, Pichert, Goetz, Schallert, Stevens, and Trollip (1976); Anderson, Pichert and Shirey (1983); and Anderson, Reynolds; Schallert, and Goetz (1977), as well as work by Bransford and his colleagues (Bransford, 1983; Bransford & Johnson, 1972) have demonstrated consistently that a reader's knowledge and assumptions about a topic influence his or her comprehension, and particularly the kind of cognitive processing required for the reader to make inferences from information in the text.

Self-monitoring: The effects of metacognition. In addition to background knowledge, the reader's ability to monitor her or his reading comprehension by using various strategies to check understanding while reading also affects reading comprehension. Building upon theoretical work by Vygotsky (1962, 1978), Brown and her colleagues (Brown, 1978, 1980, 1982; Brown & Campione, 1981; Brown & Palincsar, 1982; Brown, Palincsar, & Armbruster, 1984; Brown, Palincsar, & Purcell, 1985) conducted a series of studies of students' "metacognition," or their ability to know what they know and do not know. These studies showed not only that good readers use several strategies to comprehend what they read, but that poor readers can be taught these strategies and thereby improve their comprehension ability.

Thus, there is strong theoretical and empirical support for the role that schemata and metacognition play in understanding how and why readers demonstrate reading comprehension ability. But most of this work has been either experimental or cross-sectional in design, and very little has been conducted with beginning readers. Therefore, we do not know when readers' background knowledge first affects their comprehension. Likewise, we do not understand how and when readers learn to check themselves to be sure they comprehend what they read.

Findings from Classroom Instruction Research

As authors of several recent reviews (e.g., Brophy & Good, 1986; Good, 1983; Rosenshine & Stevens, 1984) have concluded, research on classroom instruction has made great progress in the past decade and a half. There is converging evidence from a number of correlational and experimental studies that gains in student achievement are related to three variables that Rosenshine and Stevens (1984) labeled "indices of instructional effectiveness." These indices are: (a) content covered, (b) academic engaged time, and (c) student success rate.

It is notable that none of these indices is an instructional variable in the same sense as are variables such as grouping procedures or feedback. They may be more appropriately thought of as mediating constructs or even, as suggested by Rosenshine and Stevens, as consequences of instruction rather than as ways of organizing or delivering instruction.

Content covered. Content covered is closely linked to Carroll's (1963) concept of opportunity to learn. A variety of measures of content covered have been used in previous work, including both measures of the quantity of material covered (e.g., the number of books read, the number of basals completed, or the number of textbook pages covered) and the degree of match or overlap between the material covered and the items on the test used to measure student achievement. The degree of match has been measured by teacher ratings of the proportion of students who have had an opportunity to learn the content covered by each item on a test (cf. Husen, 1967) and by analyses of the overlap between curriculum and instructional materials and items on a test (cf. Leinhardt, 1983). Despite the diversity of the measures used, content covered has consistently been found to be positively related to student achievement and the student gains in achievement.

The more recent work of Barr and Dreeben (1983) considered the social organization of classrooms and the effects of classroom organization on student performance. The researchers studied student ability,

instructional materials, time schedules, teaching goals, and teacher expertise. In addition, they examined how classroom instruction is organized and then managed in those contexts. Furthermore, they also considered the interaction of student characteristics and instruction that together influence the learning outcomes of children. Barr and Dreeben found that the difficulty of materials and observed time both predicted variance in student performance. Content coverage was most associated with learning, accounting for 83% and 71% of the variance in basal and phonics learning, respectively, and 50% in general achievement.

Academic engaged time. Results of the Beginning Teacher Evaluation Study (Fisher, et al., 1978) showed the importance of considering more than content covered or the amount of time allocated to a specific content area. In that study, classes were found to vary, not only in the amount of time allocated to a subject area, but also in the rate at which students were engaged during that time, and in the rate of errors made. Furthermore, student engagement in learning and the rate of student errors (or the converse, student success rate) were both shown to have strong relationships with student gains in achievement.

The strength of the relationship between content covered, academic engaged time, and student success rate and gains in student achievement suggests that it is important for studies of classroom instruction to attend to these instructional characteristics. However, advances in knowledge about instructional effectiveness will require research that goes beyond these global areas. This is so, in part, because of their nature. They are, as was previously indicated, mediators rather than directly observable teacher behaviors, and relatively little is known about teacher behavior that results in increased coverage of content or student engagement. Nor is it clear that the ideal student success rate is a constant regardless of subject matter, the developmental level of a student, or a student's stage of learning. For example, the most effective success rate in kindergarten may be substantially different from fifth grade.

Teacher behavior. There is, of course, a large body of research relating teacher behavior variables to student achievement. Some of this research is suggestive with regard to the types of instructional practices that are likely to increase content coverage and enhance student academic engaged time. Some of the relevant variables (e.g., grouping practices, teacher directed instruction, and use of questions and feedback) have a long history. However, researchers have placed more emphasis on quantity than on quality of instruction. Furthermore, simple counts of the number of questions or of the number of times various types of feedback is given, provide little information about effective sequencing. Therefore, leaders in research on teaching (e.g., Brophy & Good, 1986; Good, 1983) have strongly emphasized the need for researchers to give greater attention to *quality* of instruction and to analyses of instructional sequences.

Rosenshine and Stevens (1984) argue that, at a global level, research "has shown that effective teaching is characterized by a predictable sequence of demonstration, guided practice, feedback and corrections, and independent practice" (p. 788). Within this general sequence, Rosenshine and Stevens have also abstracted a description of behaviors in each stage of instruction that research has suggested lead to more effective instruction. Their conclusions regarding effective behaviors are summarized in Table 1.

The summary in Table 1 provides a rich context for organizing and analyzing classroom observation variables. It also provides a framework for the development of qualitative indicators of classroom instruction and for planning sequential analyses.

[Insert Table 1 about here.]

Findings from Longitudinal Research

To accomplish the primary objectives of this study--to understand the factors that influence the development of reading comprehension ability and to test linear structural models to explain this

development--it is necessary to study the same sample of children for a number of years. Such a study requires a longitudinal design. Only a longitudinal design permits following an individual's course of development, and this is particularly important when viewing instruction as effects of teacher behaviors and instructional materials. It is important for researchers to be able to describe these variables to explain the differences between what children knew at time 1, and what they knew at time 2. Data from a longitudinal study allow the inferences of the type "Changes in A are followed closely by Changes in B." Furthermore, a longitudinal design is less vulnerable to unidentified biases than other designs. It provides opportunities to watch reading development unfold.

Few longitudinal studies have focused on reading, and those that have done so were designed to address questions such as: Can children be taught to read in kindergarten? or Do children who read early have any long-term advantage in reading comprehension over children who learn to read later? We have, however, identified nine longitudinal studies of beginning readers. The following discussion will briefly describe each of these studies.

Studies of early readers. Studies by Durkin (1966); McKee, Brzeinski, and Harrison (1966); Beck (1973); and Durkin (1970, 1974-75) followed children through several grades.

Durkin (1966), for example, tested more than 5,000 incoming first graders in two school districts. From this group, she identified 49 early readers in one district and 157 children in the other. Her central question was whether children who were reading when they began school would maintain their advantage through the elementary grades. She followed her first group through fifth grade and her second group through third grade. The results showed significant lasting achievement differences for children who read before beginning school.

McKee, Brzeinski, and Harrison (1966) randomly assigned 4,000 entering kindergarten children from the Denver Public Schools to experimental and control conditions. Children in the experimental group were taught to read in kindergarten. Children in the control group had traditional kindergarten experiences. Further variation in experimental and control conditions continued beyond kindergarten. Children from the kindergarten experimental and control conditions were again randomly assigned to accelerated or regular first-grade instruction.

McKee et al. followed their subjects through fifth grade. They found that children who received kindergarten reading and who continued in accelerated programs outperformed first-grade starting accelerated groups, children who had been taught to read in kindergarten who shifted to regular instruction in first grade, and children who did not receive kindergarten reading.

While Durkin (1966) focused on children who read before starting school and McKee et al. studied the long-term effects of reading instruction that began in kindergarten and was accelerated through fifth grade, for her study, Beck (1973) focused on selecting children for reading instruction in kindergarten and on comparing those children's reading abilities to those of children of a matched sample. From 1967 to 1972, Beck used four predictors to select kindergarten children for reading instruction: (a) children's knowledge of letter names, (b) teacher judgment, (c) reading readiness scores, and (d) the children's perceptual abilities. She found that in each year of her study, teachers selected larger numbers of students for reading instruction. Like McKee et al., Beck was primarily interested in finding out if children in first through fifth grades who received reading instruction in kindergarten performed better in reading in the following grades than did children who had not been taught to read in kindergarten. She found statistically significant differences favoring kindergarten readers at each of five grade levels. Beck stated:

> The combination of no significant differences results of the tests for homogeneity of regression and the 'significance difference' results of the analysis of variance is very important, as it suggests that kindergarten reading instruction positively affects subsequent reading instruction, no matter what the I.Q. (p. 59)

Further support for long-term differences in children's reading achievement after kindergarten reading instruction comes from work with experimental and control groups by Durkin (1970, 1974-75). These two studies grew from her earlier research with children who read early (Durkin, 1966). She developed a program for four-year-old children, then followed those children for six years. Durkin's (1974-75) findings were very similar to Beck's (1973).

First, experimental and control children in Durkin's (1974-75) study did not differ significantly on I.Q. Second, reading achievement scores were always higher (Grades 1-4) for experimental children. These differences were statistically significant at Grades 1 and 2, but not significant at Grades 3 and 4. Significant differences were not found for boys and girls once analyses of covariance were computed with intelligence used as the covariant. Subjects' ages did not correlate with their reading scores.

Taken together, these five studies addressed two broad questions about reading: (a) Can children who read before first grade maintain that advantage over children of equal intelligence? and (b) Can students be taught to read in kindergarten if they are either randomly assigned for instruction or selected because of performance rather than intelligence? The studies provided support for beginning reading instruction in kindergarten, but they did not focus on how children develop reading comprehension ability.

Early predictors of reading success. Longitudinal studies by Stevenson, Parker, Wilkinson, Hegion, and Fish (1976) and by Lesgold, Resnick, and Hammond (1984) focused more discretely on kindergarten and first-grade predictors of later performance in reading.

Stevenson, Parker, Wilkinson, Hegion, and Fish (1976) studied 255 prekindergarten children whom they followed through third grade. These researchers were primarily interested in investigating "individual differences in cognitive activity associated with effective learning of reading and arithmetic in elementary school" (p. 377). They undertook their study because they believed that better understanding of cognitive ability could lead to preschool programs that could enhance students' later performance by preventing failure in basic skills. First, they developed a battery of measures to administer to children prior to kindergarten. These measures included 11 cognitive, and 14 psychometric tasks. They also asked for kindergarten teachers' ratings on 13 additional variables. They found fewer than half the cognitive tasks correlated significantly with reading achievement, and that the most predictive psychometric tasks dealt with words and letters. The children's prekindergarten scores on letter naming, and the visual-auditory version of the paired associates test were the best predictors of reading comprehension in second and third grade, though verbal recall was also a good predictor in second grade. These prekindergarten tasks were consistently better predictors than teachers' ratings. Similar results were also reported by Dykstra (1967), Barrett (1965), and Durkin (1974-75).

In their longitudinal study, Lesgold, Resnick, and Hammond (1984) focused on one subskill of reading, rapid word recognition. The theoretical basis for this research is that students have limited capacities for processing information. Therefore, a beginning reading approach that results in "automaticity" (LaBerge & Samuels, 1977) of word recognition will then allow students to focus attention on comprehending what they read. Lesgold and his colleagues studied children in a global curriculum (a method by which students were expected to recognize and understand whole words simultaneously) and a code-emphasis curriculum wherein students learned symbol-sound correspondences and blending skills intended to facilitate word recognition. Support for code-emphasis approaches had been reported in two major reports comparing reading program effectiveness (Resnick, 1979; Chall, 1983).

Lesgold and his colleagues designed their study to reflect "a careful plotting of the actual trajectories of reading skill development in the primary grades" (p. 4) in order to understand how word recognition develops and how the development of word recognition ability is related to reading comprehension. The Lesgold et al. work departed from the studies described earlier because they (a) had subjects from two distinct curricula, (b) tested students as they reached specific points in their curriculum, and (c) measured word reading skills in terms of reaction times for word recognition and classification of word

meanings. The primary finding from this study was that word processing speed and reading comprehension measures showed greater predictive paths "from early word processing to subsequent comprehension than vice versa" (p. 9). Therefore, Lesgold, Resnick, and Hammond (1984) concluded that during beginning reading (the first two years of instruction) children must develop word processing speed in order to comprehend what they read. In addition, the ability to comprehend what one reads builds from one year to the next. Therefore, word processing as an independent skill declines.

Two additional longitudinal studies complete this portion of the review of the extant literature. The first, by Share, Jorm, Maclean, and Matthews (1984), investigated sources of individual differences in reading achievement by studying 543 Australian children in a longitudinal study that began when the children entered kindergarten and concluded at the end of their first-grade year. Share et al. found that tests of phonological processing, interdigital dexterity, and knowledge of the alphabet were the strongest predictors of reading achievement. They also found peer ability to be as strong a predictor of reading performance as entering ability on the three types of measures.

The second study, by Juel (1988), reported on a longitudinal investigation of the reading and writing development of 54 children she followed from first through fourth grade. Juel found a correlation of .88 between end-of-first-grade and end-of-fourth-grade reading achievement. Children who entered first grade with little phonemic awareness became poor readers who by fourth grade had failed to achieve the decoding skills good readers had achieved by the start of second grade. Children who read poorly tended to become poor writers, and early writing ability failed to predict later writing ability in the same way as early reading ability had predicted later reading ability. In addition, good readers read more both in school and out of school than did poor readers.

In summary, the major findings from these nine studies suggest that (a) children who read early maintain an advantage through the middle elementary grades; (b) children can be taught to read before first grade; (c) these early readers continue to perform higher on measures of reading comprehension than children taught to read later, even when they have accelerated reading programs after kindergarten; (d) children's abilities to identify letters and word configurations prior to kindergarten instruction are better predictors of later reading comprehension ability than general cognitive or psychometric tasks; and (e) word processing ability of children in early grades results in reading comprehension ability later. Our study builds on these results by providing more detailed information about the role of classroom instructional processes, children's experiences with various reading material in the development of reading comprehension, and home influences on ability than appeared in these earlier studies.

Research Questions

How do children develop the ability to comprehend what they read in first and second grade? In the process of ferreting out answers to this primary question of our research, several more focused questions have emerged: What kind of home experiences contribute to the development of reading comprehension ability? What is the nature of these activities? What sort of things do children do independently that contribute to the development of their reading comprehension ability? How much reading instruction is there in the lower elementary grades? What are the characteristics of such instruction? How do activities at home and activities in school jointly influence the development of children's reading comprehension ability? To answer these questions, the senior members of our research team developed a simple, heuristic model prior to initiating this work.

Heuristic Model of Reading Development

Because we have explained our model in detail in Meyer, Wardrop, and Hastings (1990a) (see Figure 1), we will therefore explain it only briefly here.

[Insert Figure 1 about here.]

The simplest way to think about reading development (and therefore the process used in most previous research) is to view it as a function of students' abilities as they enter a grade. In other words, children's reading performance at the end of each grade reflects their performance at the beginning of that same grade. More complex models view reading development as a reflection of students' entry characteristics, with some continuing influence from their home backgrounds and parental resources. An even more comprehensive model might view reading performance as reflecting immediate and changing conditions each year, such as stimulation and resources provided by teachers, parents, and eventually by the children themselves through the books they read, television shows they watch, and other experiences they choose. We believe that this more complex formulation, which includes measures of home and school influences along with student ability, more accurately depicts an ecologically valid model of reading development. The first challenge in our study was to determine which influences actually mediate children's reading development. What follows is a brief discussion of how we conceptualized key home and school influences on student ability for our model.

Home Influences on Student Ability

Home background. Which home background characteristics most influence children's general ability as they enter first and second grade? At each of these grade levels, we use the home background variables described in Meyer, Wardrop, and Hastings (1990a). These form a composite made up of the hours each parent works, parents' levels of education, and parents' occupations. Further home background characteristics in our model include measures of the family constellation itself, the number of adults and of older and younger siblings at home.

Home support. What activities at home support children's reading development over time? At the first- and second-grade levels we chose to study the effects of home instruction activities, and home support for schooling as measured by parents' reports of activities such as the frequency with which they read to their children or instructed them in reading; resources, such as books and magazines they supplied for their children; and parents' reports of the children's participation in reading at home. At the second-grade level, we included an additional measure of home support-parents' reports of homework, both the frequency with which their children brought homework home and what parents did with it once it got there.

Instructional Influences on Student Ability

Which classroom activities support children's reading development over time? We made numerous choices to characterize reading instruction. We wanted to capture the primary characteristics of teachers' interactions with students and the characteristics of the textbooks used with students to teach reading. To this end, first-grade reading instruction was initially conceptualized as sentence comprehension activities and decoding activities. Time spent in reading activities, decoding interactions, comprehension interactions, teachers' feedback to students, and management styles became the latent traits to represent reading instruction at the second-grade level.

Which characteristics of the reading textbooks mediate children's learning? We described reading materials at each grade level by counting the words in the texts, various kinds of questions teachers were to ask such as those related to children's background knowledge, those to be answered from information in the text, and those that were primarily the children's opinion.

In summary, our generic heuristic model of reading development was composed of these constructs: home background characteristics, students' ability at the time they began first grade, the characteristics of the instructional materials used to teach reading, classroom teachers' management and instructional styles, home support for literacy development, and students' ability at the end of first grade. The question is how do these constructs contribute to the development of children's reading comprehension

development? The next section of this report presents a description of the methods we used to answer this question.

Methods

School Districts Studied

Three school districts in the midwest participated in this program of research. Because the districts have been described extensively elsewhere (Meyer, Wardrop, & Hastings, 1990a), the description here will be brief. The districts were selected because they represent natural variations of educational settings prevalent in America today. In addition, they were chosen because all had reputations for average to above-average student performance in reading, and all had histories of low student turnover. Furthermore, the administrators in these districts were willing to commit to our program of research for at least five years.

District A. This district's children come from a small town surrounded by a farming community. Although the approximately 80 children per grade level in the school participating in the study appear to be quite homogeneous they do, in fact, have substantial variation in ability upon entering school. A unique characteristic of this district is that teachers do very little grouping for instruction. Therefore, almost all reading in first and second grade is taught to entire classes simultaneously. The Houghton Mifflin series is used in both first and second grades.

District B. This district is primarily a commuter village, although it has a growing mobile home park and numerous families who either own or lease farmland in the area. The school participating in our study from this district has about 150 children at each grade level, and reading instruction here is quite different from that in District A. In District B, teachers divide their classes into five or six groups for daily reading instruction in the Harcourt Brace Jovanovich series. All children in first and second grade also participate in an elaborate library program, Tag Books, which greatly supplements the regular classroom reading instruction. The Tag Book practice provides additional reading experience for each child as well as one-to-one comprehension practice on each book with a parent volunteer.

District C. This district is a suburban school district. One elementary school from this district participated in the study. The school's way of managing its heterogeneous population is to group its 85 children per grade level into first- and second-grade teams. Black, Hispanic, and White children attend this school. These first and second graders are in combination homerooms for instruction and activities each day except for reading and math. For these subjects, students are usually regrouped homogeneously by grade level.

Data will be presented for each district separately in the descriptive and correlational results sections of this report. The results from the linear structural modeling will represent analyses of measures combined for the three districts.

Measures

Standardized Measures of Student Ability

While the primary thrust of our research is to account for variance in children's reading development, we believed that a certain level of verbal competence was necessary for children to learn beginning reading decoding and comprehension skills. Therefore, we included several measures of verbal-reading performance in our models. Several of these are standardized tests of verbal-reading performance that have been nationally normed.

CIRCUS Reading Test. The CIRCUS Reading Test, Level D (Educational Testing Service, 1976a) was given to our children in the spring of their second-grade year. This is a relatively traditional group-administered reading test. It is composed of a series of short passages followed by comprehension questions.

Degrees of Reading Power Test. The Degrees of Reading Power Test - Form PA8 (DRP) (College Board, 1979) was administered out-of-level at the end of the group's second-grade year. This test involves several passages, each of which is five to seven paragraphs long. Each selection has seven cloze items, each of which is purported to be understood only in the context of the preceding and following sentences. The passages increase in difficulty. Children have as much time as they need to complete this instrument.

Wide Range Achievement Test. We administered the decoding subtest of the Wide Range Achievement Test (WRAT) (Jastak, Jastak, & Bijou, 1978) in the fall and spring of both the first- and second-grade years. These items consist of a list of words children read aloud to examiners. Testing stops when children miss 12 consecutive words.

Woodcock Reading Mastery Test. The Reading Comprehension Passages of the Woodcock Reading Mastery Test (Woodcock, 1973) were administered fall and spring of the first- and second-grade years. Children read these cloze passages to an examiner. Testing is stopped after five consecutive errors.

Customized Measures of Reading Comprehension

Because we realized that standardized measures do not measure exactly all of the latent traits that we wished to study, we also modified tests developed by other researchers and created other instruments of our own.

Chicago Reading Test. The Chicago Test (Barr, 1983) is a test of word endings, word families, and nonsense words. We administered this instrument in the fall of the first-grade year.

Interactive Reading Assessment System (IRAS). The Interactive Reading Assessment System (IRAS) (Calfee & Calfee, 1982) requires students to read word lists of eight words each until a stopping rule applies or until the last list is read. Rate, accuracy, and self-corrections are recorded. Students then read passages of increasing length and difficulty until they have made more than 10 decoding errors and missed at least half of the comprehension questions. Rate, accuracy, and self-corrections are recorded for this section, as well. Correctness of response to questions based on the passages with or without a prompt is also recorded. This measure was used for LISREL (Joreskog & Sorbom, 1984) modeling (described later in this report) as a manifest variable at the beginning of second grade to assess verbal performance.

Error Detection Test. The Error Detection Test (Meyer, Hastings, & Linn, 1985) was administered both in first and second grade. This instrument attempts to measure a cognitive domain (detection of errors in three-sentence paragraphs and sequences of several short sentences), number of decoding errors, and children's ability to provide support for their definitions of errors. The instrument uses reading vocabulary common to curricula in all three school districts.

Engelmann-Meyer test of Metacognition. This test was developed from a large set of items generated by Engelmann and Meyer in 1974 to function as test-taking practice items for children in first, second, and third grades. The items are either riddles or short passages with nonsense words in them. Children are expected to figure out answers to the riddles and to answer questions about the short passages.

Weber Comprehension Test. This original instrument was developed in 1971 for testing the comprehension ability of inner-city third graders. It is composed of two 20-item sets of very short

paragraphs. The final sentence in each paragraph has a word in it that "spoils" the meaning because it is absurd. A typical item might conclude with this sentence, "I will take my car to that cat to get it fixed." The children are instructed to circle the word that spoils the meaning. The Weber Test is similar in function to the Error Detection Test. However, the Weber is designed so that the children read silently in a group setting instead of reading orally to an examiner and having their errors corrected as is the procedure used in the Error Detection Test.

Table 2 contains means and standard deviations of all these measures, both for the sample and for each district.

[Insert Table 2 about here.]

Observation System to Measure Reading Instruction

The observation system developed for kindergarten as described in Meyer, Wardrop, and Hastings (1990a) was expanded to include new interactions such as those that focused on sentence comprehension, text-explicit, and sentence comprehension text-implicit interactions. These additions accommodate changes observed in instruction as children actually learned to read connected text. These categories were differentiated on the basis of whether answers were explicitly or only implicitly stated in the text.

Home Background Measures

The measures of home background we used for these first- and second-grade analyses are the same data we used in our study of kindergarten reading development (Meyer, Wardrop, & Hastings, 1990a). The home background construct includes primarily measures of parents' levels of education and occupations, although the hours parents report that they work weekly, the number of adults in the home, and the number of older and younger siblings are also included in this construct.

Home Support Measures

First grade. Five of the six indices we used to measure home support in kindergarten (Meyer, Wardrop, & Hastings, 1990a) we used again in first grade: (a) children reading, (b) parents reading to their children, (c) resources, (d) parental instruction, and (e) inhibitors.

Second grade. There were also five indices of home support for literacy development at the second-grade level: (a) parents reading to their children, (b) the child participating in reading alone and to parents, (c) parental resources, (d) parental support, and (e) parental instruction.

Procedures

Ability: Time 0

This point in our heuristic model always represents the beginning of the school year. We used several measures each fall to develop the latent trait entering ability. At the beginning of first grade, three instruments were used: the decoding subtest of the WRAT, the Woodcock Reading Comprehension Passages, and the Chicago test.

At the beginning of second grade, the WRAT decoding subtest and the Woodcock Reading Comprehension Passages were again administered, along with the IRAS, the Error Detection Test, and the CIRCUS-Listen to the Story Test (Educational Testing Service, 1976b). We believe that these individually administered decoding and comprehension tests along with the group-administered listening

test, provide a means of measuring the latent traits of entering ability at the beginning of first and second grade.

Ability: Time 1: Reading Development

This point in our model represents the end of each year. Reading ability was conceptualized in a fairly complex way at the end of first grade and an even more complex way at the end of second grade. These latent traits were formulated by administering a battery of reading instruments that varied in their intent to represent different aspects of reading. Factor analyses later revealed the variety of reading behaviors represented in the model.

We continued to give the WRAT and the Woodcock. In addition, we re-administered the IRAS and the Error Detection Test. Further measures of reading ability were taken with two group-administered tests of the children's abilities to detect errors in passages, the Weber Comprehension Test and the Engelmann-Meyer Test of Metacognition. Two more traditional tests of reading comprehension, the CIRCUS Reading Test, and the Degrees of Reading Power Tests were also given.

Collectively, the use of these instruments allowed us to study reading development as characterized by decoding and comprehension ability, the ability to detect errors in passages, and the more global, traditional ability to illustrate one's understanding of a passage by answering questions about it. Thus, reading development was viewed as a variety of areas of expertise that together represent the latent trait reading development.

Descriptive Results

Instruction

First grade. First-grade teachers were observed for nine full days each. Table 3 presents the frequencies of interactions, minutes spent, and frequencies of management statements (such as critical comments made to students), and the average number of 5-minute segments when teachers were not instructing entire classes (sweeps) per year first for the entire sample and then for each of the three districts. Each of these frequencies is reported at the individual child level.

[Insert Table 3 about here.]

The overall general pattern was for children in District A to receive both interaction frequencies and time greater than the sample mean for most of these categories, for District B students to receive close-to-the-sample mean, and for District C students usually to receive close-to or below-the-sample mean instruction in each category.

First graders averaged about 1 1/2 letter-sound interactions, more than 2 whole word interactions, a little over 1 interaction each for sentence reading and background knowledge, and less than 1 text-tied comprehension interaction that was either text-explicit or text-implicit each day. Children received far more text-explicit than text-implicit interactions. Teachers corrected students by giving them hints, demonstrating, or otherwise remaining engaged with them until they could produce a correct answer. Less often, they simply repeated a question.

These children received very little instructional time decoding without a text, approximately 1 minute for the sample, though more than 2 minutes in District A. They spent far more time (over 7½ minutes for the sample) decoding with text materials. They spent on average only 3½ minutes each day reading from a text such as a trade book or basal reader.

Critical statements from teachers to students were high for the sample and generally high in each district, although the standard deviations are large both for the sample and each district. The 5-minute segments teachers are not giving instruction to their entire classes were identified as sweeps. Therefore, each mean for sweeps can be multiplied by 5 to represent the number of minutes those children averaged working independently. These calculations are over an hour for the sample, less than an hour for District A, quite a bit over an hour in District B, and again over an hour in District C.

Second grade. Second-grade teachers were also observed for nine full days using the same observation system that was used with the first-grade teachers. Twelve classroom process variables represent these observational data. Seven of the variables were combined into one variable for the LISREL analysis. These variables are identified with NACT after their names in Table 4. The five variable names followed by asterisks are those for which square root transformations were done on the original (positively skewed) variables. All of the variables in the NACT composite have to do with interactions focused on letters or sounds, whole word reading, oral sentence reading, background knowledge, or word comprehension interactions. Once again, sentence comprehension questions were coded as either text-explicit or text-implicit.

[Insert Table 4 about here.]

The results shown in Table 4 reveal that an average child in the sample received less than 1 letter-sound interaction during a single observation, more than 3 interactions while reading whole words, less than 1 word or sentence comprehension interaction, and far less than 1 interaction of encouragement or suggestion-to-reexamine form of feedback. These second graders also averaged less than 1 background knowledge interaction each.

Children from District A generally received higher rates of instructional interactions than did children in the other two districts. Exceptions to this statement are that District C children received more letter-sound and background knowledge interactions than did children in the others districts. District C children clearly received the greatest amount of both instructional and general feedback. District A students continued to receive by far the most time in reading instruction, almost 20 minutes per day as compared to less than 7 minutes a day in District B and 8 minutes a day in District C. These dramatic differences in reading instructional time are due in large part to the grouping practices in Districts B and C and the continued whole class instruction in District A.

Home Background

Our home background measures showed that fathers of our subjects frequently had a community college education and worked in business at managerial levels. A high percentage of the mothers were homemakers, although mothers of District C children were an exception. The families generally had two adults and one child older and half a child younger than the child in our study. Mothers of District C children and fathers of District B children tended to work the most (see Table 5).

[Insert Table 5 about here.]

Home Support

First grade. The frequencies reported by each district on our home support measures were actually quite similar for kindergarten and first grade. Parents of District A children again reported their children to have the greatest participation in reading (reading alone). They also continued to show the most support for their children while reading and the least instruction. Parents of District A children also claimed that their children had the most homework. Parents of District B children reported the greatest resources available to their children (see Table 6).

[Insert Table 6 about here.]

Second grade. Parents of District C children continued to report that they read to their children more than parents in the other two districts. District B children read alone most often, according to their parents. Parents of District B children as a group provided the most resources and gave the most support to their second graders, although parents of District C tried to instruct their children more than did the parents in the other two districts (see Table 7).

[Insert Table 7 about here.]

Correlational Results

First Grade

Table 8 shows the correlations of all first-grade variables used in the analyses. There are surprisingly few high correlations between measures of home support and other indices. An exception is shown in the relationship between the child participating in reading and IRAS subscores. Parental resources, support, instruction, and the amount of homework given, all produced low or even negative correlations with student performance.

[Insert Table 8 about here.]

The achievement measures generally show strong intercorrelations between both decoding measures and comprehension measures. The classroom process variables also produced high intercorrelations. Thus, teachers who have high frequencies of letter-sound interactions with students also tend to have high frequencies of whole word and sentence reading interactions with them. This produces a general cluster of interactions focused on decoding. These same teachers also have high frequencies of comprehension interactions, those coded for background knowledge, and comprehension, both text-explicit and text-implicit. While these correlations are generally also high for time in decoding both with and without a text, they are lower for time actually reading textbooks. Teachers' feedback by repeating questions or leading has low correlations with other instructional processes except whole word interactions and sentence reading interactions. Seatwork, on the other hand, is generally negatively correlated with the other measures.

Second Grade

Table 9 presents correlations of all second-grade variables used in either the initial or final structural models. The first 15 variables represent the tests administered in the fall and spring. The correlations of the decoding and comprehension measures, particularly those that were individually administered, are quite high in the fall (WRAT and Woodcock, r = .825, for example) and in the spring (WRAT and Woodcock, r = .759). The correlations between fall and spring performance on the same measure are equally high (WRAT fall to WRAT spring, r = .81 and Woodcock fall to Woodcock spring, r = .756). Mother's and father's educations are highly correlated, mother's education and occupations are moderately correlated. Fathers' occupations are fairly highly correlated with their educations.

There were no high correlations for any of the five parental support indices with any of the other variables. There were only moderate correlations for parents reading to their children and parents instructing children; children reading and parental resources; and parental support and parental instruction.

High and moderate correlations exist between teachers' use of letter sounds or names and time spent in decoding as well as sustained feedback in the form of teachers' encouraging students or suggesting to them that they re-examine their answers. Similar relationships are evident between whole word

reading and sentence reading interactions, and time spent in decoding as well as sentence reading and word level comprehension interactions. Background knowledge interactions are moderately correlated with feedback that encourages students, whereas word comprehension interactions are highly correlated with time in reading as well. The sustained feedback categories are highly correlated with each other. This suggests that teachers who maintain interactions with their students by encouraging them until they can come up with the correct answer also sustain interactions with them by asking them to reexamine their answers until they are correct. Finally, there is a moderate correlation between sentence comprehension interactions that are text-explicit and those that are text-implicit.

[Insert Table 9 about here.]

Structural Modeling of Reading Development: First-Grade Analyses

These analyses were completed following the procedures specified for LISREL as described by its developer (Joreskog, 1978) and in the LISREL VI User's Guide (Joreskog & Sorbom, 1984). A detailed description of these procedures, notes on reading structural diagrams, and general characteristics of these data can be found in Meyer, Wardrop, and Hastings, 1990a.

We began the first-grade modeling with 55 variables to be considered. The results of our preliminary exploratory analyses in which we considered frequency of occurrence of classroom behaviors, distributional characteristics of the variables, correlational relationships, and preliminary factor analyses to examine possible features of the measurement models led us to remove 8 variables and to combine two others as a simple sum. We therefore began our structural modeling analyses with 46 variables. Preliminary LISREL analyses led to eliminating an additional 4 variables and combining two others, so that the preliminary model depicted in Figure 2 is based on 41 manifest variables.

[Insert Figure 2 about here.]

Using an iterative strategy, we arrived at the model portrayed in Figure 3. This final model retained 36 variables. In the following discussion, we first summarize the measurement models for exogenous and endogenous variables, then describe the structural model that accounts for interrelationships among the constructs in the model.

[Insert Figure 3 about here.]

Measurement Model Components

In this first-grade model, we have 7 constructs with multiple indicators, two observed variables used without modification, and two single-indicator variables with measurement error explicitly included in the model. These variables and relationships are all portrayed in Figure 3. In this model, only the variables related to home background are exogenous, in sharp contrast to the kindergarten model presented in Meyer, Wardrop, and Hastings (1990a) and to models of science learning that we have examined elsewhere (Meyer, Wardrop, & Hastings, 1990bc).

Home background characteristics. As in the kindergarten model, the parental education and occupation variables clustered into a composite we designate as Home Background. Consistent with the kindergarten results, the education variables play a substantially larger role in defining this composite than do the occupational prestige measures. Only one other home characteristic was retained in this model: Number of Adults in the Home. This variable was retained because it has a significant relationship to the other composite involving characteristics of the home, to be described next.

Home support indicators. The three variables that cluster into a composite index of Home Support for Reading are Child's Participation in Reading, Parental Support for Reading, and an index of Parental Resources. The index of Child's Participation dominates, with a loading of .85; Parental Support and Parental Resources have loadings of only .51 and .31, respectively.

Two other variables that were obtained as a part of the Transitory Home Characteristics set also appear in the model: the index of Parental Instruction and the Amount of Homework reported. The inclusion of these variables is especially important, as they represent the first evidence that what happens at school influences what happens at home, which in turn affects performance in school. No such connections were identified for the kindergarten model.

Classroom observation variables. The complexity of the interrelationships among teacher classroom behaviors is quite clear from the structure in Figure 3. Of the 12 variables retained, three are associated uniquely with the composite we labeled Sentence Comprehension Activities, two are uniquely associated with the Decoding Activities composite, and the remaining seven have significant loadings on both of these composites. (The Sentence Comprehension Activities composite plays no significant role in the structural model, but it was retained because of its function in accounting for interrelationships among the classroom observation variables.) Each of these composites was named largely on the basis of the indicator with the dominant loading: Time Decoding Without Text for the Decoding Activities composite, and Sentence Comprehension (Text-Explicit) Interactions for the Sentence Comprehension Activities composite.

One other classroom variable appears in the model in Figure 3: Frequency of Independent Seatwork. This variable is shown with a measurement error of .19, indicating a reliability of approximately .81. It has a significant positive effect on both end-of-year composites, Decoding Attainment and Word Meaning Attainment.

Beginning-of-year performance tests. Three tests given at the beginning of first grade--the Chicago, Woodcock, and WRAT--formed a clearly defined composite that we have labeled simply Reading Achievement: Beginning Grade 1. The smallest loading of any of these on the composite is .70, for the Woodcock, and it was necessary to allow correlated errors for the Woodcock and WRAT, which correlate so highly with each other that their relationship cannot be accommodated by a composite that includes any other measure.

End-of-year performance tests. Both the IRAS and Error Detection Test were given at the end of first grade. Each test yields a number of subscores, so that there were many more potential variables to accommodate at this point. The final model retained five IRAS scores, three Error Detection scores, and performance on both the WRAT and the Woodcock. These 10 variables formed two composites. The first composite, which is by far the more coherent of the two, includes both the WRAT and Woodcock (again with correlated errors), the five IRAS subscores, and the Decoding Errors score from the Error Detection Test. Coefficients range from .68 for the IRAS: Average Relative Reading Rate, Passages subscores to .90 for both the WRAT and the Average Relative Errors, Words subscores from the IRAS. The second composite is defined primarily by the Word Reading Errors subscores from the Error Detection Text (with a loading of .93), with much smaller contributions from the other four measures: Error Detection Sequence Reading Errors (.47), the two passage performance measures from the IRAS (with loadings .24 and .23), and the Decoding Errors summed score form the Error Detection Test (.15).

Structural Model Components

Because it is important to keep in mind, we repeat that the structural model we present in Figure 3 is not the only possible model that would account for the observed relationships among these 36 variables. It is, however, consistent with both those observed relationships and with some commonly held notions

about how learning might take place at this grade level. The model depicted in Figure 3 had a chi-square of 1376.08 with 555 degrees of freedom (X^2/df = 2.48), a goodness-of-fit index of .82, and a root-mean-square residual value of .069.

Home-based variables. Home background had significant positive effects on both Home Support for Reading (.14) and beginning-of-the-year Reading Achievement: Beginning (.34). Number of Adults Living in the Home was negatively related to Home Support (-.19), possibly suggesting the effect of competing demands for adult time that arise when there are more adults. The Home Support composite also had a significant positive effect (.39) on initial performance. The combination of background and support accounted for 30% of the variance in the beginning achievement composite.

Relationships involving initial achievement, classroom activities, and final performance. Unlike the kindergarten model, (Meyer, Wardrop, & Hastings, 1990a) this first-grade model involves effects of students' initial achievement on teacher classroom behaviors and effects of classroom activities on some home-based indicators (Amount of Homework and the index of Parental Instruction). Initial achievement had a significant positive effect on the frequency of classroom decoding activities (the greater the entry-level skills, the more the teacher engaged in the cluster of behaviors we have called Decoding Activities), and a significant negative effect on the frequency of activities related to sentence comprehension (greater entry level skills, fewer behaviors in the Sentence Comprehension Activities cluster). This negative effect may be at least partially an artifact of the nature of the measurement model for classroom activities, in which the majority of indicators (7 of 12) have significant loadings on both composites. That is, there may be some kind of (statistical) "compensatory effect" operating here.

There was also a direct path from initial achievement to Amount of Homework reported, with a -.25 coefficient. Students with lower entry-level skills apparently took more schoolwork home with them than did those whose entry skills were higher. In addition, there was a positive effect of Decoding Activities composite on Amount of Homework reported. The more the teacher engaged in those activities related to the teaching of decoding, the more schoolwork the students took home. There was also a positive link from Amount of Homework to the index of Parental Instruction, suggesting that parents whose children brought more schoolwork home tended to engage in more home teaching activities. Finally, both Amount of Homework (-.14) and Parental Instruction (-.15) were negatively related to end-of-year Decoding Attainment. Although these are shown as possible causal paths in the model, it is probably more accurate to view them as indicating consistency with the earlier negative path from initial performance to Amount of Homework. That is, students whose skills were lower to begin with reported more homework and a higher index of parental instruction, but finished first grade with skills that still tended to be below average.

As is almost universally true in studies of educational attainment, entry level performance is by far the best predictor of final performance. These data are no exception. Beginning-of-the-year reading achievement had a large direct "effect" (.71) on end-of-year decoding attainment and a moderate direct effect (.34) on end-of-year word meaning attainment. Neither "classroom activities" cluster was significantly related to the end-of-year word meaning composite, but the Decoding Activities composite had a significant positive (.31) effect on end-of-year decoding attainment.

Finally, the frequency with which students engaged in independent seatwork had significant positive effects on both Decoding Attainment (.29) and Word Meaning Attainment (.24).

Some Special Features of the First-Grade Structural Model

Although they have already been mentioned, a few features of the model in Figure 3 deserve further attention. At the first-grade level, we see the beginnings of an interplay between entry-level skills and teachers' classroom activities. What teachers do appears to be influenced by the skills students bring with them. In addition, classroom activities affect some home behaviors, in that higher frequencies of

decoding activities are linked with more schoolwork taken home. Finally, in addition to the direct paths described above, it is of interest to note the magnitude of some of the total effects (direct paths plus indirect effects) of some of these composites on end-of-year decoding attainment: Home Background, .34; Home Support, .40; Beginning-of-Year Reading Achievement, .98; Decoding Activities, .27; and Frequency of Individual Seatwork, .29.

Second-Grade Analyses

As we move up through the grades, the models that seem to account satisfactorily for reading achievement become increasingly complex: more variables, more complicated measurement structures, more structural connections among variables and constructs. We began this analysis of second-grade performance with 52 variables, using the model depicted in Figure 4. After eliminating some and algebraically combining others to achieve a positive-definite correlation matrix (see Table 9 for specifics), our initial LISREL analysis involved 47 variables.

[Insert Figure 4 about here.]

Using the same overall strategy as for previous grades, we arrived at the model portrayed in Figure 5, in which 37 variables remain. As before, we first summarize relationships in the measurement models for exogenous and endogenous variables, then describe the structural model used to account for interrelationships among constructs.

[Insert Figure 5 about here.]

Measurement Models

Home background and home support variables. In contrast to results from kindergarten and (tentatively) first grade, the home-based variables--both stable and secular--were all exogenous for second grade. Among the variables presumed to be stable over time, the education/occupation indicators continued to cluster as indicators of the Home Background composite. At this level, the only other background variable that had any significant and meaningful relationship with the rest of the model was Number of Older Siblings. The secular home variables again formed two composites, although the groupings do not exactly match those from either of the previous years. We continue to label these two composites Home Instruction Activities, represented with almost equal strength by the indices of parental instruction (.90) and parental resources (.88); and Home Support for Schooling, which incorporates three indices: Parents Reading to Child (.65), Parental Support (.31), and Parental Resources (-.45). One way of interpreting these loadings on the Home Support composite is to say that there is an expected level of both parental support and parents reading to the child, given the parental resources summarized in that index. It is the extent to which the Support and Reading indices *exceed* these expectations (or, conversely, the extent to which Resources measure up short of what one would expect on the basis of the Support and Reading indices) that is represented here. That is, this Home Support composite may reflect the kind of "extra-effort" activities that parents undertake in support of their child's learning. The other variable in this category, the index of Child's Participation in Reading, stands alone and for that reason seems to take on special importance in this second-grade model (see below in the section presenting the structural model).

Classroom observation variables. Only 12 of the classroom-based variables remained in the final model for second grade. These 12 variables formed three overlapping clusters. The first seems to be characterized by activities and interactions emphasizing decoding and is therefore labeled Decoding Activities. The second seems to be dominated by indicators focused on reading comprehension at the sentence level and has been labeled Sentence Comprehension Activities. The third appears to involve observations reflecting a teacher's style in relating to students during reading instruction and has,

because of the nature of the indicators involved and the pattern of their loadings on this composite, been labeled Interactive Teaching.

The observed variable with the largest loading (.81) on the Decoding Activities composite is Time Spent in Decoding during reading instruction, with a strong secondary contribution (.70) from Word Comprehension Interactions and moderately strong components involving Sentence Reading Interactions (.51) and Whole Word Interactions (.52). Interestingly, Teacher Praise to Class once again shows up with a negative loading (-.38).

Variables represented in the Sentence Comprehension Activities composite are dominated by the Sentence Comprehension (Text Explicit) Interactions (.73) and Sentence Comprehension (Text Implicit) Interactions (.56), along with Background Knowledge Interactions (.41) and minor contributions from Letter-Sound Interactions (.25), Sentence Reading Interactions (.12) and Feedback: Teacher Encourages (.21).

Two feedback variables, Suggests Re-examination (.83) and Teacher Encourages (.81), dominate the Interactive Teaching composite variables, with strong secondary contributions from Letter-Sound Interactions (.57), Teacher Criticisms (.44), and Background Knowledge Interactions (.37). Although this composite did not have a significant effect on end-of-year reading achievement, it was retained in the model because of its importance in accounting for interrelationships among classroom-observation variables. In earlier analyses, there was another composite variable involving classroom observation variables, but it was (a) unrelated to other constructs in the model and (b) uninterpretable. Consequently, it was dropped from the model, and the factor structure it subsumed was accommodated by allowing correlations among the "errors" (i.e., uniquenesses) associated with those classroom variables involved, where necessary.

Beginning-of-year performance tests. With the inclusion of the IRAS and Error Detection measures, the fall tests of reading performance formed two composites, one that seemed to emphasize decoding skills and a second whose interpretation was less clear and has (only tentatively) been labeled Comprehension Attainment: Beginning 2nd. The correlation between these two composites is not fully accounted for by those antecedent variables in the model, so that the residuals from the two had a covariance of .46 (representing a correlation of about .58).

Six measures comprised the Comprehension Attainment composite, with all loadings ranging from .74 to .90. (Three of these variables represented measures of errors and therefore had negative loadings.) Two of the three standardized tests, the WRAT (.90) and Woodcock (.88), along with the total score on questions about reading passages from the IRAS (.86), dominated this composite.

The second composite was defined primarily by the Listening subtest from the CIRCUS battery, with a loading of .84. Although they were based on performance errors, two of the remaining variables, Error Detection: Word Errors (.67) and Error Detection: Sequence Errors (.51), had positive loadings on this factor. The final variable, Error Detection: Decoding Errors (formed by summing the Word Decoding Errors and Sequence Decoding Errors scores), had a small negative loading (-.14). Exactly what this factor represents is not clear. One possibility that is yet to be tried is to eliminate the CIRCUS Listening measure, which has been problematic throughout these analyses, and see if the remaining beginning-of-year tests still form two factors.

End-of-year tests. The six tests administered at the end of second grade formed a single composite that we have called Reading Achievement: End 2. The Reading score from the CIRCUS (.92), the Woodcock (.91), and the Engelmann-Meyer (.87) had the largest loadings on this composite, but the other three (WRAT, Weber, and Degrees of Reading Power) all had loadings in the high .70's.

Structural Model Components

A statistically and practically significant development occurred for the second-grade model, as for the first time it became necessary to treat classroom observation constructs (composites) as endogenous variables, affected by either home characteristics (a path from Home Background to Decoding Activities) or beginning-of-year student performance (a path from Comprehension Attainment: Beginning 2nd to Interactive Teaching).

Home-based variables. All three home-based composites and the two single-indicator variables had significant effects on both beginning-of-year constructs. Different from previous years, the parents education/occupation composite (Home Background) had only a small effect on beginning-of-year decoding performance (.07), but continued to have a moderate impact on "understanding" performance (.49). The index of Child's Participation in Reading now had a moderate positive effect on decoding (.47) and made a small but significant contribution to "understanding" (.06). Note the apparent complementarity of effects from these two sources.

As was true for the kindergarten analysis (but not for first grade), the number of older siblings was negatively related to both indicators of beginning-of-year performance (-.14 with decoding, -.17 with "understanding"). The two composite measures derived from the secular characteristics of home environment provide yet another contrast in the nature of their effects: the Home Instruction composite had a strong negative impact on decoding performance (-.73) and a small positive impact on "understanding" (.11), while the Home Support for Schooling composite had a moderate positive effect on decoding (.40) and a moderate negative impact on "understanding" (-.31).

As mentioned in the introduction to this section, some effects of home-based and beginning-of-year variables on classroom behaviors were found for the first time with these second-grade data. Specifically, there was a moderate negative effect (-.33) of the Home Background composite on the frequency of classroom events forming the Decoding Activities composite, suggesting that teachers engaged in more of those activities with students from homes where the parental education and parents' occupational prestige levels were lower. Given the small negative effect of Decoding Activities on end-of-year achievement, it appears that this increased emphasis may be counterproductive.

The other effect on teacher behaviors is represented in the moderate negative effect of beginning-of-year decoding performance on the classroom composite we have called Interactive Teaching (-.42). There was clearly a tendency for teachers to engage in more of the behaviors identified as interactive teaching with students whose beginning-of-year decoding performance was poorer (more "encouraging" feedback, more feedback suggesting re-examination, more criticism directed to both the class as a whole and individuals in the class, and greater frequencies of background knowledge and letter-sound interactions). Although the Interactive Teaching composite did not itself directly affect end-of-year achievement, three of the five behaviors also contributed to the Sentence Comprehension Activities composite, which *did* have a small positive effect on end-of-year performance (.14). Thus, this adaptation of teaching behavior to entry-level student skills appears to have had a very slight beneficial effect on student performance.

Other influences on end-of-second-grade reading achievement. The effects of classroom variables on end-of-year achievement have already been described in the preceding section. What remains is to note that both beginning-of-year performance composites had direct, positive relationships to end-of-year achievement, although comprehension (.75) had a far stronger impact than did decoding (.21). This model accounts for 85% of the variance in end-of-year achievement, with beginning-of-year decoding performance alone accounting for about 56%.

Highlights of the Second-Grade Structural Model

Several interesting developments are worth noting in connection with this model. First, the influence of students entry-level skills on teacher classroom behavior continues, although without any effect on end-of-year performance. The path from Decoding Attainment: Beginning 2nd to Interactive Teaching has a moderate negative coefficient (-.42), suggesting that it is with the less proficient students that teachers engage in such behaviors as suggesting reexamination, providing encouraging feedback, criticizing, and emphasizing letter-sound and background knowledge interactions. Interestingly, this cluster of teacher behaviors did *not* show a significant relationship to end-of-year reading achievement.

Another new result is the link between students' home background and those teacher behaviors subsumed under the Decoding Activities composite (time spent on decoding activities; letter-sound, whole word, word comprehension, and sentence reading interactions; and teacher praise to the class). We have resisted incorporating such paths into these models, but this one was simply too strong to be omitted. It suggests that teacher behavior is, in some cases, influenced by students' home background directly and not through the indirect effects of home background as it influences students' entry-level skills.

Also, home background and the secular home characteristics all have the status of exogenous variables in this model. The Home Instruction Activities and Home Support for Schooling composites, as well as the index of Child's Participation in Reading, appear no longer to be directly influenced by home background as they were in models at the lower grade levels. With the exception of the path from Home Background to Decoding Activities, all home-based measures influence end-of-year reading achievement only indirectly, through their effects on entry-level performance on the measures of decoding and comprehension.

Finally, the measurement structure of our assessments of reading achievement indicated two factors--one primarily decoding, the other primarily comprehension--at the beginning of second grade, and only one general achievement factor by the end of the year. This pattern is in direct contrast to that for first grade, where we began with a single, undifferentiated factor and ended with two distinct factors representing decoding and word comprehension.

Discussion

This section will focus first upon patterns and issues raised in the first- and second-grade models. It will then present findings from this program of research that are possible solely because of the longitudinal design.

First, it is clear the whereas mothers' educational levels (and parents' occupations and education levels in general) are very important to children's entry abilities at the kindergarten and first-grade levels, these effects are quite diminished by second grade. We believe that we may see diminished effects from the home background variables in part because of the effects of schooling.

Second, the consistent findings in first grade for positive effects from activities in homes where the children were actively involved in reading is very encouraging. This suggests that it is important to have children practice at home what they learn in school. It also suggests that more passive activities for children, such as parents' reading to them, are much less related to children's *reading* development once children begin to read than they are earlier in the children's lives, before they can read. It appears that at the first- and second-grade levels, reading to children is not related to the children's increased reading achievement. It is likely, however, that being read to while learning to read will contribute to long-term vocabulary and language development. This question can be addressed at a later print in this study.

Third, once children are actually in school, the way teachers teach reading strongly affects children's performance. Time spent in reading was clearly important to reading success. Teachers' "braiding" of comprehension and decoding instruction, even at these grades levels, appears to affect both. Children's decoding and comprehension performances appear to be tightly interwoven. If these children could not identify words correctly, they failed to derive meaning from text.

Fourth, the positive results of seatwork may have resulted from the fact that at these grade levels, the independent work children did was most often directly related to teachers' instruction. Therefore, these activities provided children additional practice on central skills, particularly sound-symbol relationships, that they were also being taught in the teacher-directed portions of their lessons.

Fifth, it is not at all surprising that children of lower ability took home more work. In one of the three schools, the only children to receive written work regularly in first grade were the lower performers. These children took home work to share with their parents on a daily basis.

Sixth, it is interesting to note that while children's entering abilities failed to influence teachers' behaviors at the beginning of kindergarten, first- and second-grade teachers were influenced by the ability levels of the children they taught. It is at these grade levels that children are grouped and often tracked for instruction, whereas kindergarten classes are truly heterogeneous.

Seventh, the failure of neither the decoding nor the comprehension classroom composite to effect comprehension at the end of first grade suggests that end-of-first grade comprehension measures may have been so easy to understand that they were not sensitive to instruction. This interpretation seems particularly plausible because we see different effects at the second-grade level. In short, first-grade reading is composed of words that were easy to understand.

Eighth, of particular interest is the formation of the latent traits at the end of each grade level. At the end of kindergarten and the end of first grade we find two constructs, decoding achievement and word meaning (comprehension) achievement. By the end of second grade, we find just one construct, reading achievement. The fall constructs present a very different pattern. Each measure stands alone at the beginning of kindergarten. At the beginning of first grade, the results of the factor analysis revealed just one construct, reading achievement. At the beginning of second grade, two factors were again present. We interpret this pattern of divergent and convergent decoding and comprehension ability as depicting the developing nature of the ability to read. The initial stages of reading show the independent nature of word recognition and meaning though these two merge temporarily at the beginning of first grade, where comprehension is easy because at this level children are not faced with reading text they do not understand. These abilities separate again as text demands become more complicated, and therefore more independent until they converge again at the end of second grade.

This evidence of diverging and converging decoding and comprehension ability in reading development is but one important finding that is particularly interesting because of the longitudinal design of this work. Two other longitudinal findings have emerged as we have examined these data. First, when comparing results among the three districts on the two measures given at least once a year, it was clear in each year of the study, that despite no significant differences between districts at the beginning of the study there were significant and striking differences between districts by the end of kindergarten. These differences were explained by differences in teachers' instructional and the managerial processes that had preceded them (Meyer, Hastings, and Wardrop, 1989). The districts' rank orders in achievement were stable through first grade but they shifted rather dramatically at the end of second grade. Once again, these changes in rankings are often explained by differences observed in teachers during the school year preceding the shift in student performance rankings among districts. We have come to think of this phenomenon as "waves of effectiveness." First we see variance in teachers' behaviors, then we see variance in students' test scores.

In summary, there is substantial overlap in the findings for reading comprehension development from year to year. There are also numerous findings that are unique at each grade level. Last, and certainly not least, there are some findings that are possible only because this is a longitudinal study.

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Table 1

Effective Behaviors in Four Stages of Instruction
(Based on Rosenshine & Stevens, 1984)

Stage	Effective Behaviors
Demonstration	1. small steps 2. many examples 3. interspersed questions to check student understanding
Guided Practice	1. frequent questions 2. direct focus on materials 3. continued until a high student success rate is achieved
Feedback/Corrections	1. brief affirmation of a correct response 2. hints, simpler questions, or explanation following an incorrect response
Independent Practice	1. active monitoring 2. sufficient for overlearning and rapid responding

Table 2

Means and Standard Deviations of All First- and Second-Grade Measures of Student Ability

	Sample		Dist. A		Dist. B		Dist. C	
	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
WRAT, F1	28.51	7.93	31.02	8.78	27.65	5.19	27.23	1.35
WOOD, F1	3.51	5.38	4.70	6.32	2.58	3.84	3.89	6.39
CHICAGO, F1	31.46	24.53	45.02	24.11	26.42	21.11	25.38	25.30
WRAT, S1	49.02	9.42	52.35	8.70	48.22	7.92	46.83	11.76
IRAS, S1:								
REL ERWDS	.37	.94	.02	.73	.47	.92	.58	1.09
REL R WDS	.27	.91	-.06	.68	.46	.86	.27	1.11
REL ER PSG	.36	1.07	-.03	.72	.41	.93	.69	1.46
REL R PASS	.29	1.06	-.09	.76	.44	.87	.44	1.50
SUM CORRECT	35.57	24.24	44.05	23.46	34.00	23.82	29.17	23.59
WOOD, S1	21.89	11.43	24.88	10.26	20.84	9.94	20.56	14.52
ERROR DET, S1:								
WORD ERS	8.82	1.58	8.84	1.14	8.89	1.32	8.47	2.28
DECOD ERS	7.10	4.10	5.53	3.42	7.36	3.38	8.37	5.44
SEQ ERS	3.73	1.46	3.66	1.54	3.88	1.37	3.51	1.52
WRAT, F2	49.40	9.78	52.80	8.58	49.70	8.96	46.50	11.17
WOODCOCK, F2	21.60	10.64	23.70	9.47	21.80	10.57	19.30	11.44
IRAS, F2:								
REL ER WDS	.37	.96	.01	.61	.42	.93	.63	1.17
REL ER PSG	.26	.89	.05	.56	.15	.66	.64	1.30
SUM CORRECT	38.30	24.57	44.30	22.27	39.00	24.13	31.30	25.94
ERROR DET:								
WORD ERS	9.00	1.17	9.00	.82	9.30	.71	8.60	1.81
DECOD ERS	22.20	23.45	14.90	12.59	21.70	20.36	30.10	32.42
SEQ ERRORS	4.10	1.43	4.20	1.37	4.30	1.35	3.80	1.56
CRCS LST, F2	33.20	5.17	33.80	3.16	34.20	3.68	31.10	7.76
WRAT, SPR2	61.40	7.94	62.60	7.48	61.60	7.34	60.00	9.11
WOODCOCK, S2	37.00	10.20	37.20	8.38	38.30	10.16	34.60	11.39
CRCS RDG, S2	31.60	7.74	33.40	6.41	31.60	7.16	30.20	9.36
DEG RD PWR, S2	28.30	11.44	25.00	10.79	30.00	10.75	26.80	12.19
ENG-MEYER, S2	27.70	8.30	27.10	8.07	29.10	7.59	26.00	9.28
WEBER, S2	18.20	5.51	18.50	5.11	19.20	4.60	16.30	6.71

Table 3

Means and Standard Deviations of All First-Grade Measures of Classroom Process Variables

Measure	Sample		Dist. A		Dist. B		Dist. C	
	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
Freq. of Interac:								
Letter Sds	1.55	.92	1.87	1.17	1.54	.73	1.19	.82
Whole Word	2.36	1.18	3.01	1.59	2.04	.85	2.26	.89
Sent. Rdg.	1.09	.63	1.52	.80	.84	.40	1.09	.54
Background Know	1.25	1.03	1.67	1.23	.93	.70	1.39	1.14
Sent Comp, TE	.57	.75	.52	.70	.56	.69	.64	.92
Sent Comp, TI	.17	.22	.21	.19	.12	.16	.23	.32
Repeats Ques FB	.20	.31	.11	.09	.25	.37	.19	.32
Leads FB	.47	.55	.42	.45	.57	.66	.34	.40
Minutes Spent:								
Decoding w/o Text	1.13	1.12	2.38	1.13	.66	.71	.67	.59
Decoding w Text	7.63	4.66	8.73	3.46	6.80	4.32	8.00	6.01
Rdg. in Text	3.53	1.25	4.68	1.29	2.87	.78	3.53	1.00
Management Strat.:								
Criticisms	28.92	14.38	28.80	14.85	30.62	15.32	25.74	11.26
Sweeps	13.24	4.11	10.28	4.59	14.79	2.56	13.60	4.29

Table 4

Means and Standard Deviations of All Second-Grade Measures of Classroom Process Variables

	Sample		Dist. A		Dist. B		Dist. C	
Measure	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
Freq. of Interac:								
LTR-SND NACT*	.81	.66	.86	.47	.74	.45	.90	1.01
WHOLE WD NACT	3.20	3.09	5.30	3.48	2.40	2.40	2.70	2.88
SEN RDG NACT*	.65	.41	.82	.34	.66	.46	.47	.32
BK KNOW NACT	.98	.85	.74	.45	1.01	.86	1.15	1.10
WD COMP NACT*	.36	.36	.72	.24	.28	.32	.17	.25
SEN COMP NACT (TXT EXPLICIT)	.45	.53	.44	.55	.57	.57	.27	.35
SEN COMP NACT* (TXT IMPLICIT)	.34	.35	.42	.30	.38	.36	.18	.32
FB: T ENCRGS	.27	.35	.17	.18	.24	.28	.41	.50
FB: SUG REEXM	.17	.31	.12	.11	.17	.27	.22	.46
Minutes Spent:								
TIME DECOD'G	10.40	7.80	19.60	4.90	6.70	4.03	8.10	8.10
Management Strat:								
PRAISE TO CLS	2.90	1.92	2.30	1.29	2.20	1.24	4.50	2.37
CRITICISM*	12.80	4.11	11.30	2.25	12.50	4.49	14.80	4.08

*Square root transformation of original (positively skewed) variable

Table 5

Means and Standard Deviations of Measures of Home Background

	Sample		Dist. A		Dist. B		Dist. C	
Measure	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
Mother's Ed	3.70	1.13	3.37	.88	3.69	.96	4.25	1.56
Father's Ed	3.76	1.35	3.58	1.14	3.73	1.19	4.07	1.88
Mother's Occup	42.86	10.21	40.48	8.77	42.30	10.18	48.14	10.76
Father's Occup	44.12	13.70	41.60	11.35	43.15	13.38	50.78	16.02
Younger Sibs	.49	.62	.52	.61	.48	.62	.48	.66
Older Sibs	.98	1.13	.95	1.23	1.00	1.08	.95	1.14
# Adults Home	1.96	.45	1.89	.31	1.97	.38	2.04	.71
Hrs M Wks Wkly	20.21	18.13	18.20	18.95	20.55	18.18	22.47	16.68
Hrs F Wks Wkly	45.70	10.03	46.08	10.19	46.11	9.39	43.98	11.37

*Square root transformation of original (positively skewed) variable

Table 6

Means and Standard Deviations of All First-Grade Measures of Home Support for Literacy Development

	Sample		Dist. A		Dist. B		Dist. C	
Measure	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
C Participating	9.70	2.14	10.36	1.85	9.78	2.01	8.74	2.41
Parental Resources	15.27	4.15	15.00	3.59	15.60	4.14	14.86	4.76
Parental Support	5.57	1.32	1.32	1.12	5.58	1.32	5.45	1.55
Parental Instruc	5.43	1.89	1.89	1.78	5.50	1.86	5.60	2.05
Amt of Homework	.58	.50	.50	.38	.47	.50	.51	.50

Table 7

Means and Standard Deviations of All Second-Grade Measures of Home Support for Literacy Development

	Sample		Dist. A		Dist. B		Dist. C	
Measure	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
P Rdg to C	3.5	1.03	3.2	1.08	3.4	1.00	3.8	.96
C Participating	9.6	1.56	9.5	1.47	9.7	1.57	9.4	1.64
Parental Resources	21.0	4.76	20.8	4.65	21.6	4.69	20.1	4.90
Parental Support	2.0	.92	2.1	.90	2.2	.94	1.8	.86
Parental Instruc	8.7	3.15	8.2	3.13	8.7	2.95	9.4	3.46

Table 8

Correlations of First-Grade Measures of Student Ability, Classroom Process Variables, and Home Support for Literacy Development

	Child Progr in Reading	Parental Resources	Parental Support	Parental Instruction	Amount Homework	WRAT Fall '84	Woodcock Fall '84	Chicago Fall '84	WRAT Spring '85	IRAS Avg Rel Ern WD	IRAS Avg Rel Rate W	IRAS Avg Rel Ern PSG	IRAS Avg Rel Rate P	IRAS Sum Rz all PSG	Woodcock Spring '85	Err Dect Decode Errs	Err Dect Word Errs	Err Dect Seq Errs	Lr-sed Instrctns
Child Progr in Reading	1.000																		
Parental Resources	0.285	1.000																	
Parental Support	0.440	0.194	1.000																
Parental Instruction	0.056	0.294	0.116	1.000															
Amount Homework	0.019	-0.012	0.011	0.220	1.000														
WRAT Fall '84	0.320	0.175	0.141	-0.140	-0.183	1.000													
Woodcock Fall '84	0.211	0.073	0.059	-0.108	-0.162	0.827	1.000												
Chicago Fall '84	0.257	0.109	0.130	-0.143	-0.096	0.762	0.646	1.000											
WRAT Spring '85	0.306	0.139	0.061	-0.277	-0.279	0.675	0.541	0.650	1.000										
IRAS: Avg. Rel. Ern, WD	-0.330	-0.161	-0.137	0.292	0.238	-0.587	-0.430	-0.634	-0.812	1.000									
IRAS: Avg. Rel. Rate, W	-0.332	-0.247	-0.137	0.098	0.145	-0.564	-0.407	-0.566	-0.625	0.619	1.000								
IRAS: Avg. Rel. Ern, PSG	-0.412	-0.197	-0.153	0.138	-0.238	-0.533	-0.367	-0.556	-0.785	0.793	0.595	1.000							
IRAS: Avg. Rel. Rate, P	-0.385	-0.253	-0.210	0.047	0.159	-0.605	-0.471	-0.575	-0.673	0.667	0.724	0.721	1.000						
IRAS: Sum Rz, all PSG	0.327	0.122	0.063	-0.227	-0.211	0.581	0.446	0.665	0.785	-0.749	-0.584	-0.687	-0.562	1.000					
Woodcock Spring '85	0.315	0.198	0.103	-0.189	-0.232	0.684	0.587	0.694	0.848	-0.772	-0.667	-0.718	-0.668	0.772	1.000				
Err Dect: Decode Errs	-0.315	-0.160	-0.123	0.248	0.245	-0.607	-0.435	-0.630	-0.802	0.822	0.659	0.815	0.774	-0.747	-0.760	1.000			
Err Dect: Word Errs	0.212	0.146	0.185	0.056	-0.097	0.236	0.173	0.255	0.368	-0.363	-0.266	-0.512	-0.489	0.325	0.346	-0.471	1.000		
Err Dect: Seq. Errs	0.170	0.134	0.147	0.057	-0.185	0.222	0.164	0.250	0.304	-0.299	-0.185	-0.343	-0.289	0.330	0.308	-0.299	0.429	1.000	
Lr-Sed Instrctns	-0.010	-0.088	-0.035	-0.056	0.072	-0.142	-0.109	-0.084	-0.054	0.057	0.056	0.072	0.043	0.015	-0.035	0.047	-0.090	-0.028	1.000
Whole Wd Instrctns	0.027	-0.140	0.020	-0.035	0.230	-0.094	-0.081	-0.036	-0.106	0.057	0.045	0.089	0.001	-0.047	-0.122	0.031	-0.079	-0.022	0.595
Sntc Rdg Instrctns	-0.038	-0.127	-0.038	-0.094	0.118	-0.082	-0.007	0.018	0.107	-0.049	-0.075	0.029	-0.074	0.035	0.004	-0.033	-0.091	-0.054	0.654
Rtg Knwl Instrctns	0.044	-0.019	0.038	-0.020	0.056	0.103	0.109	0.103	0.121	-0.173	-0.204	-0.075	-0.181	0.105	0.155	-0.097	-0.064	0.010	0.320
Sntc Comp Tx Exp Nct	-0.146	-0.117	-0.076	0.033	-0.004	-0.234	-0.118	-0.207	-0.128	0.142	0.176	0.200	0.163	-0.098	-0.173	0.190	-0.096	0.077	0.089
Sntc Comp Tx Impl Nct	-0.026	-0.076	0.020	0.039	0.081	-0.069	-0.045	-0.084	-0.090	0.046	0.047	0.038	0.016	-0.034	-0.101	0.063	0.000	0.016	0.427
Time Ded no Text	0.132	0.013	0.056	-0.041	0.351	0.177	0.127	0.241	0.104	-0.135	-0.190	-0.141	-0.199	0.111	0.109	-0.158	-0.048	-0.099	0.148
Time Ded with Text	0.018	-0.073	-0.029	-0.068	-0.029	-0.137	-0.147	-0.098	0.027	-0.045	-0.100	-0.014	-0.092	0.000	-0.009	-0.065	0.046	-0.060	0.483
Time Rdg in Text	0.074	-0.066	0.066	-0.105	0.161	0.118	0.070	0.221	0.137	-0.238	-0.187	-0.141	-0.233	0.136	0.094	-0.187	-0.086	0.025	0.310
Fdbk: Rept Question	-0.099	-0.112	-0.043	-0.069	-0.059	-0.193	-0.145	-0.197	-0.115	0.117	0.176	0.190	0.143	-0.121	-0.200	0.128	-0.071	0.085	0.207
Fdbk: Tchr Leads	-0.021	-0.031	-0.028	-0.140	-0.125	-0.134	-0.120	-0.066	-0.024	-0.015	0.019	0.025	0.046	0.006	-0.045	0.007	-0.009	-0.035	0.273
Frequency Seatwork	0.063	0.041	0.042	0.053	-0.248	0.034	-0.071	-0.072	0.080	-0.054	0.007	-0.121	-0.071	0.029	0.032	-0.096	0.220	0.185	-0.053
Tchr Crit to Class	0.054	0.105	0.028	0.019	0.215	-0.015	-0.037	-0.068	-0.062	0.071	-0.069	0.035	-0.058	-0.038	-0.016	-0.052	0.050	-0.150	0.245
No. Adults in Home	-0.135	-0.108	-0.134	-0.012	-0.096	-0.124	-0.099	-0.062	-0.095	0.057	0.151	0.134	0.195	-0.088	-0.064	0.118	-0.084	-0.118	0.036
Mother's Education	0.010	0.200	0.114	0.050	-0.255	0.248	0.176	0.205	0.146	-0.170	-0.216	-0.154	-0.224	0.141	0.173	-0.253	0.197	0.151	-0.176
Father's Education	0.120	0.165	0.126	0.033	-0.238	0.319	0.211	0.294	0.238	-0.221	-0.237	-0.252	-0.275	0.194	0.244	-0.299	0.135	0.080	-0.245
Mother's Occupat'n	-0.025	0.113	0.090	0.009	-0.169	0.140	0.095	0.088	0.112	-0.093	-0.131	-0.104	-0.127	0.069	0.119	-0.173	0.142	0.008	-0.074
Father's Occupat'n	0.034	0.108	0.087	-0.109	-0.249	0.234	0.158	0.231	0.185	-0.180	-0.207	-0.172	-0.242	0.169	0.220	-0.215	0.124	0.089	-0.171

	Whole Wd Intrctns	Sntc Rdg Intrctns	Big Knwl Intrctns	Sntc Comp Tx Exp Net	Sntc Comp Tx Impl Net	Time Ded No Text	Time Ded with Text	Time Rdg in Text	Fdbk: Rept Question	Fdbk: Tchr Leads	Frequency Seatwork	Tchr Crit to Class	No. Adults in Home	Mother's Education	Father's Education	Mother's Occupat'n	Father's Occupat'n
Whole Wd Intrctns	1.000																
Sntc Rdg Intrctns	0.636	1.000															
Big Knwl Intrctns	0.302	0.515	1.000														
Sntc Comp Tx Exp Net	0.436	0.534	0.274	1.000													
Sntc Comp Tx Impl Net	0.447	0.390	0.291	0.473	1.000												
Time Ded No Text	0.356	0.406	0.334	-0.166	0.087	1.000											
Time Ded with Text	0.248	0.434	0.289	0.440	0.243	-0.184	1.000										
Time Rdg in Text	0.599	0.628	0.607	0.171	0.390	0.619	0.158	1.000									
Fdbk: Rept Question	0.244	0.138	0.185	0.480	0.077	-0.339	0.202	0.068	1.000								
Fdbk: Tchr Leads	0.330	0.247	0.003	0.179	0.163	-0.054	0.196	0.111	0.011	1.000							
Frequency Seatwork	0.002	-0.319	-0.318	0.041	0.126	-0.675	0.031	-0.333	0.270	0.095	1.000						
Tchr Crit to Class	0.087	0.183	0.035	0.019	-0.112	0.233	0.261	-0.194	-0.154	0.009	-0.289	1.000					
No. Adults in Home	-0.034	0.035	0.016	0.062	0.023	-0.097	0.058	-0.030	0.020	-0.010	0.018	-0.055	1.000				
Mother's Education	-0.144	-0.132	-0.023	-0.138	0.035	-0.118	-0.174	-0.078	-0.119	-0.014	0.234	-0.005	-0.030	1.000			
Father's Education	-0.187	-0.209	-0.078	-0.211	-0.078	-0.111	-0.171	-0.109	-0.171	-0.083	0.189	-0.069	-0.017	0.640	1.000		
Mother's Occupat'n	-0.127	-0.094	-0.056	-0.080	-0.063	-0.078	-0.155	-0.070	-0.042	-0.016	0.135	0.004	-0.077	0.508	0.344	1.000	
Father's Occupat'n	-0.165	-0.096	-0.043	-0.161	-0.012	-0.024	-0.122	-0.066	-0.196	-0.009	0.028	0.029	0.021	0.531	0.664	0.390	1.000

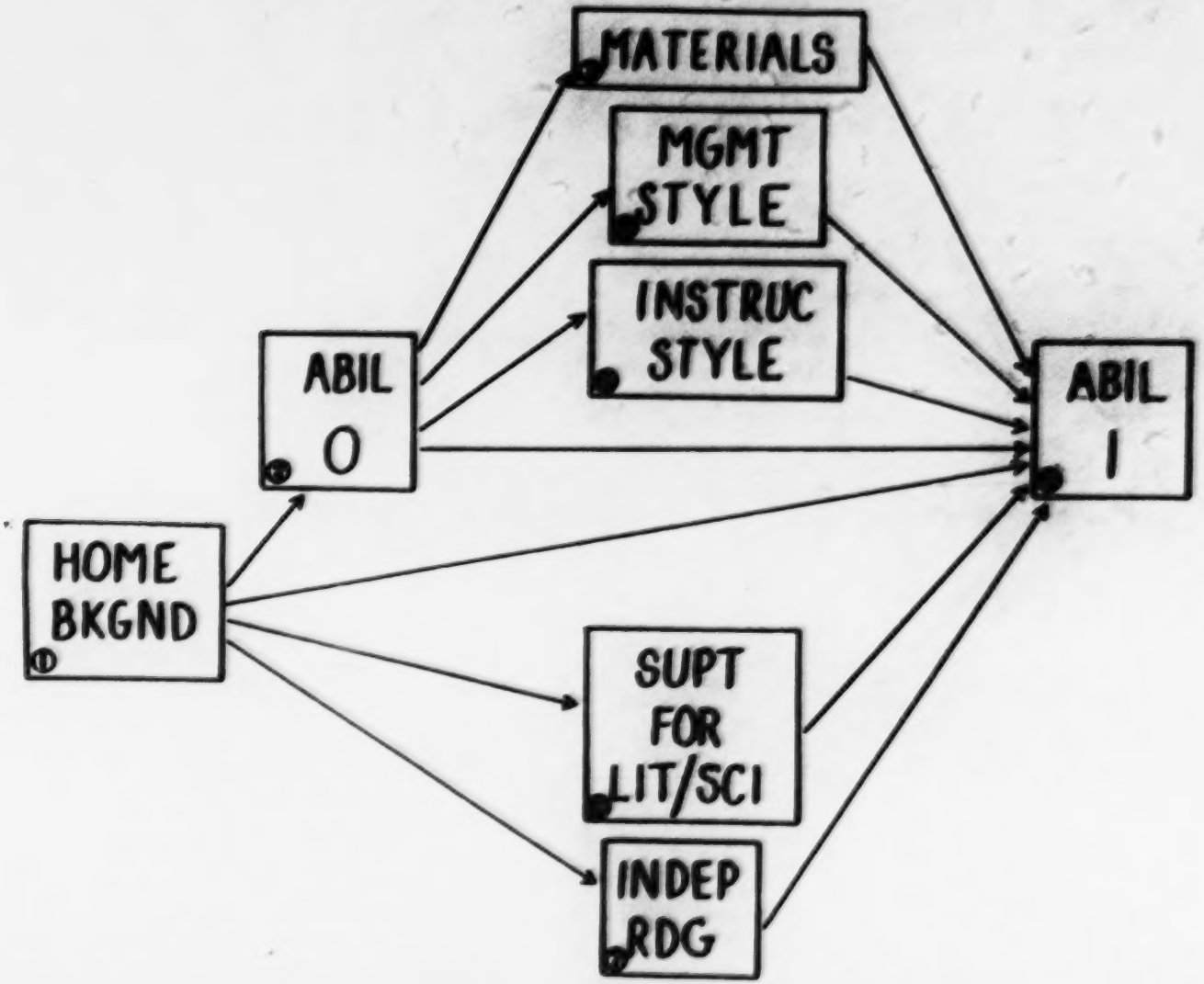
Table 9

Correlations of Second-Grade Measures of Student Ability, Classroom Process Variables, and Home Support for Literacy Development

	WRAT Fall '85	Woodcock Fall '85	IRAS: Avg Rel Err WD	IRAS: Avg Rel Err PSG	IRAS: Sum Rt all PSG	Err Dect Word Errs	Err Dect Decode Errs	Err Dect Sntc Errs	Circ List Fall '85	WRAT Spr '86	Woodcock Spr '86	Crss Rdg Spr '86	Dg Rd Pwr Spr '86	Eng-Meyer Spr '86	Weber Spr '86	Mother's Education	Father's Education	Mother's Occupat'n
WRAT Fall '85	1.000																	
Woodcock Fall '85	0.825	1.000																
IRAS: Avg Rel Err, WD	-0.855	-0.774	1.000															
IRAS: Avg Rel Err, PSG	-0.696	-0.588	0.710	1.000														
IRAS: Sum Rt all PSG	0.769	0.804	-0.795	-0.623	1.000													
Err Dect Word Errs	0.398	0.289	-0.335	-0.369	0.277	1.000												
Err Dect Decode Errs	-0.781	-0.683	0.828	0.774	-0.706	-0.477	1.000											
Err Dect Sntc Errs	0.376	0.353	-0.308	-0.303	0.353	0.339	-0.392	1.000										
Circ List Fall '85	0.435	0.439	-0.412	-0.376	0.396	0.590	-0.488	0.416	1.000									
Wrat Spr '86	0.811	0.711	-0.696	-0.592	0.642	0.304	-0.616	0.277	0.351	1.000								
Woodcock Spr '86	0.729	0.756	-0.697	-0.598	0.687	0.370	-0.676	0.368	0.497	0.759	1.000							
Crss Rdg Spr '86	0.725	0.701	-0.738	-0.616	0.709	0.403	-0.717	0.370	0.554	0.712	0.803	1.000						
Dg Rd Pwr Spr '86	0.534	0.634	-0.519	-0.426	0.557	0.291	-0.479	0.372	0.467	0.555	0.706	0.676	1.000					
Eng-Meyer Spr '86	0.623	0.657	-0.630	-0.542	0.643	0.355	-0.620	0.330	0.544	0.640	0.787	0.795	0.744	1.000				
Weber Spr '86	0.589	0.543	-0.614	-0.528	0.513	0.391	-0.620	0.312	0.442	0.587	0.696	0.714	0.535	0.687	1.000			
Mother's Education	0.136	0.213	-0.182	-0.145	0.188	0.180	-0.201	0.208	0.340	0.168	0.272	0.258	0.358	0.280	0.197	1.000		
Father's Education	0.210	0.268	-0.228	-0.245	0.263	0.271	-0.256	0.220	0.299	0.214	0.308	0.272	0.343	0.289	0.257	0.674	1.000	
Mother's Occupat'n	0.065	0.074	-0.098	-0.071	0.050	0.141	-0.096	0.091	0.150	0.126	0.209	0.161	0.231	0.177	0.132	0.497	0.356	1.000
Father's Occupat'n	0.172	0.220	-0.197	-0.202	0.220	0.117	-0.177	0.157	0.230	0.205	0.226	0.196	0.255	0.232	0.187	0.546	0.656	0.403
# Older Siblings	-0.094	-0.121	0.165	0.075	-0.113	-0.010	0.103	-0.142	-0.192	-0.025	-0.124	-0.099	-0.107	-0.089	-0.031	-0.041	-0.028	0.055
Par Reads to Child	-0.059	-0.035	0.058	0.062	-0.022	-0.062	0.059	-0.006	-0.027	0.008	-0.008	-0.010	-0.035	-0.050	-0.017	0.245	0.201	0.268
Child Ptcpt in Reading	0.147	0.131	-0.140	-0.133	0.126	0.024	-0.131	0.110	0.054	0.148	0.183	0.208	0.191	0.175	0.151	-0.010	0.040	-0.158
Parental Resources	-0.007	0.075	0.031	-0.025	-0.023	-0.008	0.011	0.054	0.046	-0.057	0.066	0.027	0.036	0.005	-0.053	-0.090	-0.020	-0.205
Parental Support	0.068	0.036	-0.111	-0.019	0.101	0.010	-0.062	0.100	0.125	0.059	0.114	0.087	0.037	0.031	0.095	0.179	0.191	0.075
Parental Instructn	-0.147	-0.154	0.169	0.080	-0.229	-0.016	0.180	-0.033	-0.078	-0.160	-0.138	-0.180	-0.170	-0.189	-0.182	-0.005	0.007	-0.062
Ltr-Snd Intretns	-0.120	-0.186	0.176	0.129	-0.180	0.022	0.129	-0.065	-0.112	-0.094	-0.125	-0.140	-0.177	-0.166	-0.092	-0.147	-0.158	-0.158
Whole Wd Intretns	-0.068	-0.165	0.093	0.084	-0.115	0.045	0.054	-0.031	-0.096	-0.148	-0.175	-0.177	-0.268	-0.226	-0.175	-0.234	-0.151	-0.079
Sntc Rdg Intretns	0.120	0.077	-0.086	-0.120	0.041	0.102	-0.150	0.009	0.112	0.129	0.096	0.125	0.024	0.067	0.205	-0.147	-0.065	-0.174
Bkg Knwl Intretns	-0.161	-0.199	0.158	0.067	-0.201	0.046	0.078	0.029	-0.064	-0.116	-0.101	-0.106	-0.107	-0.099	-0.058	-0.083	-0.148	-0.029
Wrd Comp Intretns	0.155	0.076	-0.165	-0.104	0.139	0.059	-0.165	0.096	0.041	0.074	0.010	0.050	-0.049	-0.007	0.035	-0.235	-0.136	-0.134
Sntc Comp Tx Exp Net	-0.001	0.014	-0.048	-0.101	0.030	0.041	-0.096	-0.036	0.012	0.034	0.106	0.091	0.061	0.103	0.151	-0.039	-0.033	-0.170
Sntc Comp Tx Imp Net	0.007	-0.009	0.015	-0.036	0.008	0.091	-0.016	0.090	0.090	0.015	0.041	0.023	0.001	0.046	0.015	-0.069	-0.073	-0.147
Time Decoding	0.111	0.021	-0.073	-0.022	0.033	0.048	-0.069	0.044	0.000	0.036	-0.046	0.032	-0.210	-0.111	-0.002	-0.286	-0.185	-0.261
Fdbk: Tchr Enc'rages	-0.233	-0.286	0.243	0.212	-0.280	-0.004	0.202	-0.102	-0.195	-0.180	-0.241	-0.248	-0.215	-0.224	-0.146	-0.127	-0.215	-0.059
Fdbk: Sugg Re-exam	-0.249	-0.306	0.305	0.209	-0.300	-0.011	0.261	-0.062	-0.140	-0.189	-0.258	-0.310	-0.254	-0.307	-0.227	-0.195	-0.194	-0.022
Tchr Praise to Class	0.156	0.167	-0.153	-0.043	0.158	0.054	-0.120	0.072	0.116	0.137	0.106	0.147	0.146	0.126	-0.014	0.254	0.205	0.178
Teacher Criticisms	0.154	0.144	0.159	0.167	-0.113	-0.092	0.154	-0.069	-0.221	-0.124	-0.128	-0.175	-0.060	-0.110	-0.135	-0.079	-0.055	0.033

	Whole Wd Intrctns	Satc Rdg Intrctns	Big Kawl Intrctns	Satc Comp Tx Exp Nct	Satc Comp Tx Impl Nct	Time Ded No Text	Time Ded with Text	Time Rdg in Text	Fdbk: Rept Question	Fdbk: Tchr Leads	Frequency Seatwork	Tchr Crit to Class	No. Adults in Home	Mother's Education	Father's Education	Mother's Occupat'n	Father's Occupat'n
Whole Wd Intrctns	1.000																
Satc Rdg Intrctns	0.636	1.000															
Big Kawl Intrctns	0.302	0.515	1.000														
Satc Comp Tx Exp Nct	0.436	0.534	0.274	1.000													
Satc Comp Tx Impl Nct	0.447	0.390	0.291	0.473	1.000												
Time Ded No Text	0.356	0.406	0.334	-0.166	0.087	1.000											
Time Ded with Text	0.248	0.434	0.289	0.440	0.243	-0.184	1.000										
Time Rdg in Text	0.599	0.628	0.607	0.171	0.390	0.619	0.158	1.000									
Fdbk: Rept Question	0.244	0.138	0.185	0.480	0.077	-0.339	0.202	0.068	1.000								
Fdbk: Tchr Leads	0.330	0.247	0.003	0.179	0.163	-0.054	0.196	0.111	0.011	1.000							
Frequency Seatwork	0.002	-0.319	-0.318	0.041	0.126	-0.675	0.031	-0.333	0.270	0.095	1.000						
Tchr Crit to Class	0.087	0.183	0.035	0.019	-0.112	0.233	0.261	-0.194	-0.154	0.009	-0.289	1.000					
No. Adults in Home	-0.034	0.035	0.016	0.062	0.023	-0.097	0.058	-0.030	0.020	-0.010	0.018	-0.055	1.000				
Mother's Education	-0.144	-0.132	-0.023	-0.138	0.035	-0.118	-0.174	-0.078	-0.119	-0.014	0.234	-0.005	-0.030	1.000			
Father's Education	-0.187	-0.209	-0.078	-0.211	-0.078	-0.111	-0.171	-0.109	-0.171	-0.083	0.189	-0.069	-0.017	0.640	1.000		
Mother's Occupat'n	-0.127	-0.094	-0.056	-0.080	-0.063	-0.078	-0.155	-0.070	-0.042	-0.016	0.135	0.004	-0.077	0.508	0.344	1.000	
Father's Occupat'n	-0.165	-0.096	-0.043	-0.161	-0.012	-0.024	-0.122	-0.066	-0.196	-0.009	0.028	0.029	0.021	0.531	0.664	0.390	1.000

Figure 1. Heuristic Model of Science Knowledge Development



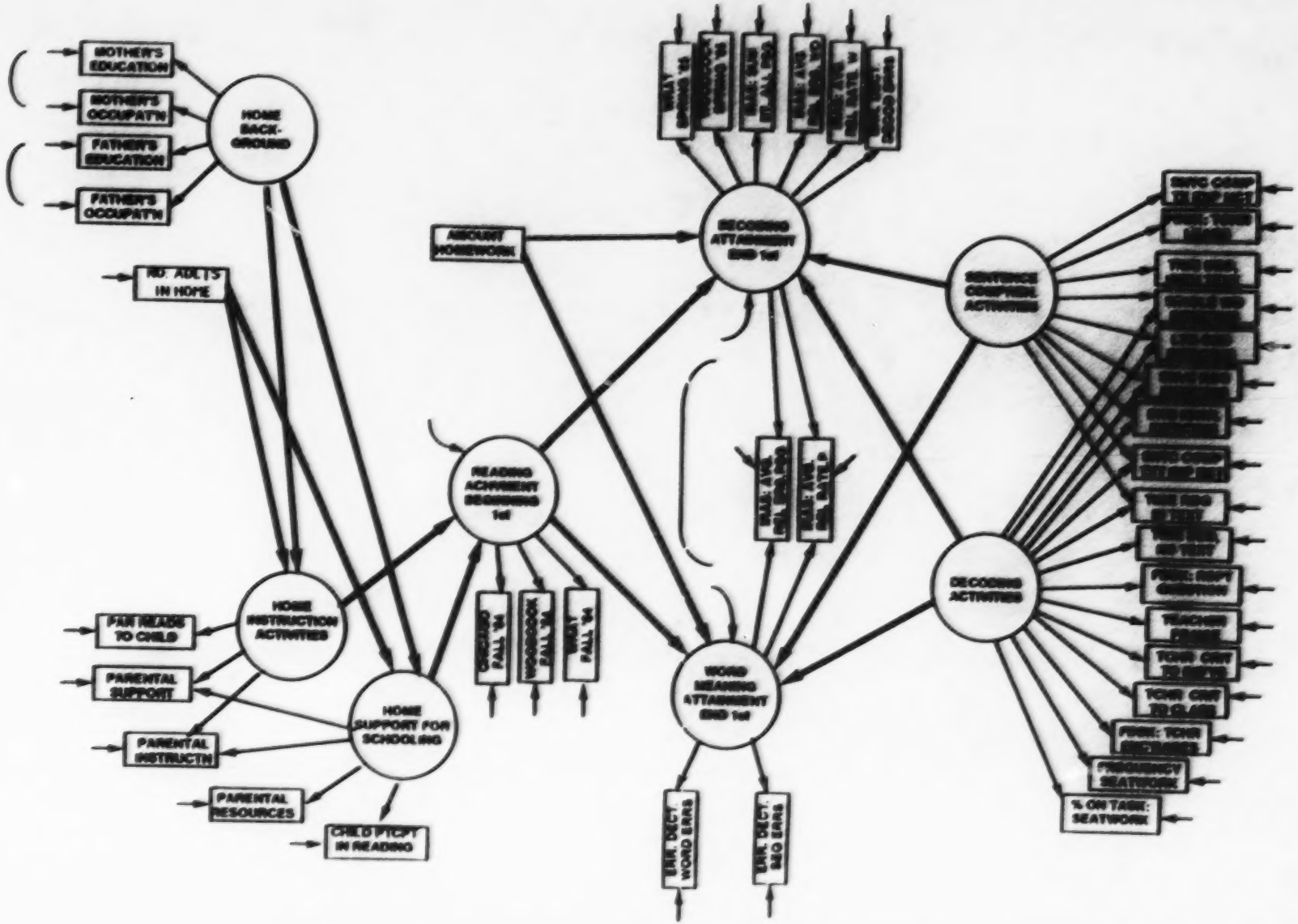


Figure 2. Medial Structural Model for First Grade Reading

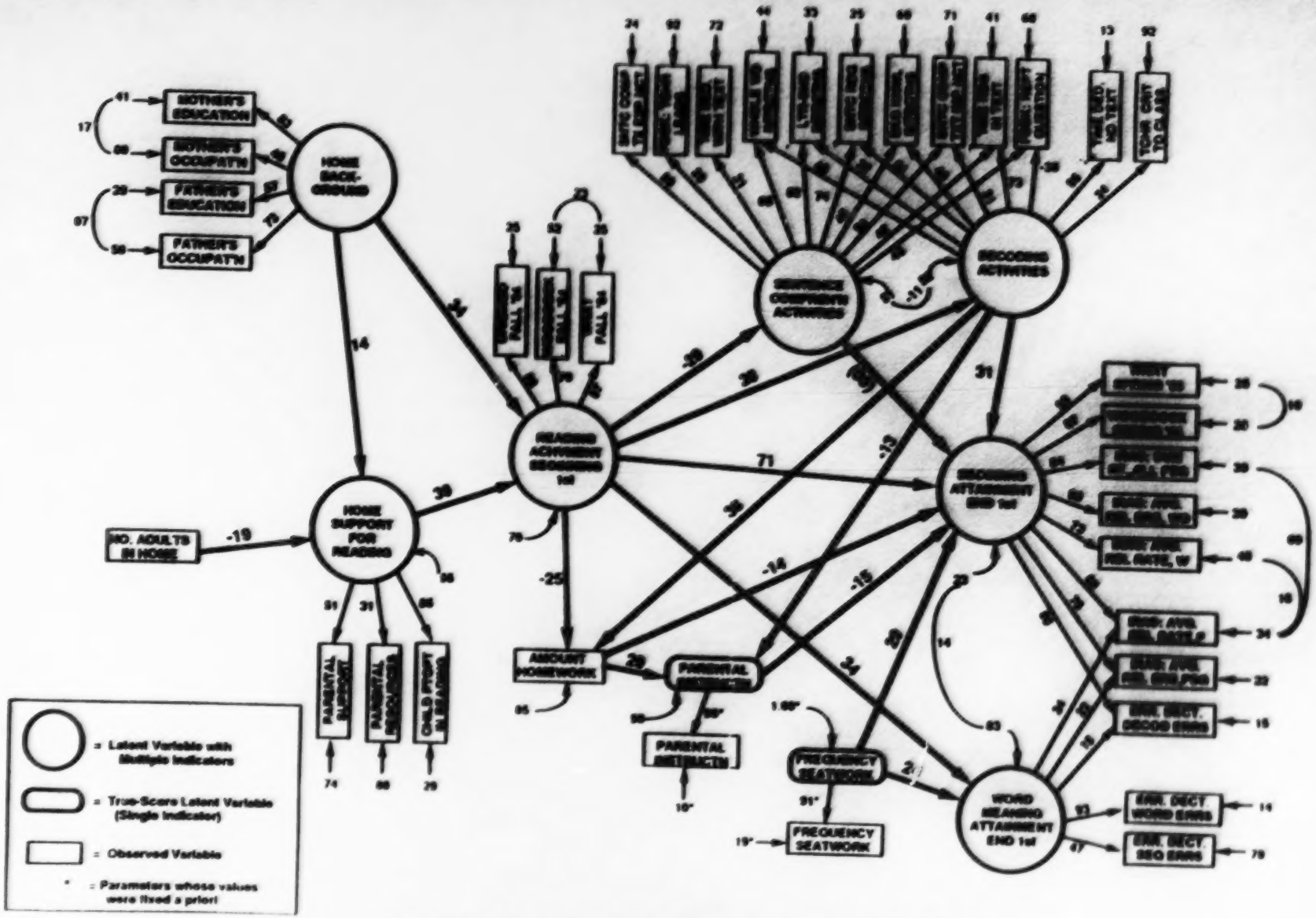


Figure 3. Final Structural Model for First Grade Reading

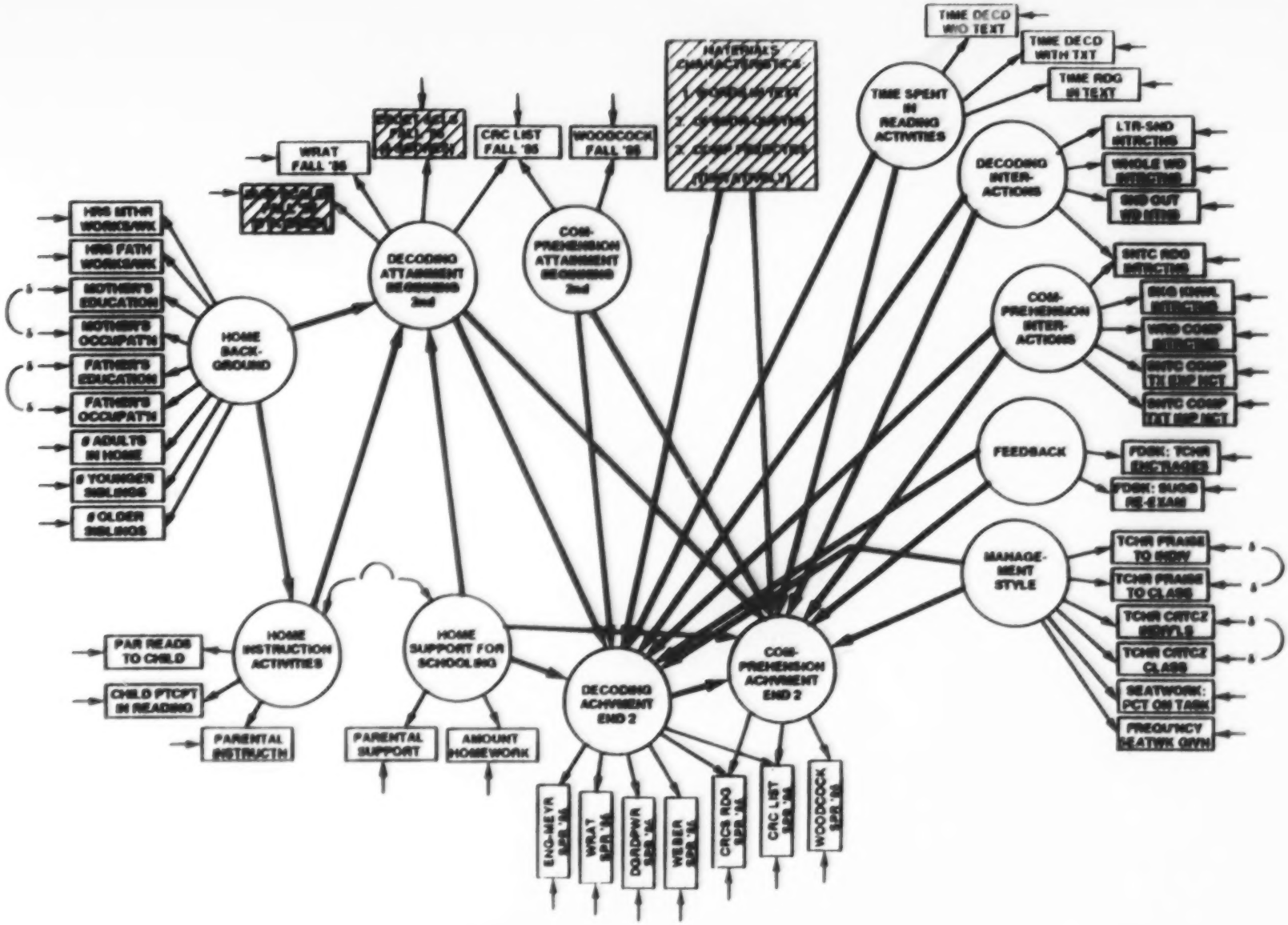


Figure 4. Initial Structural Model for Second Grade Reading

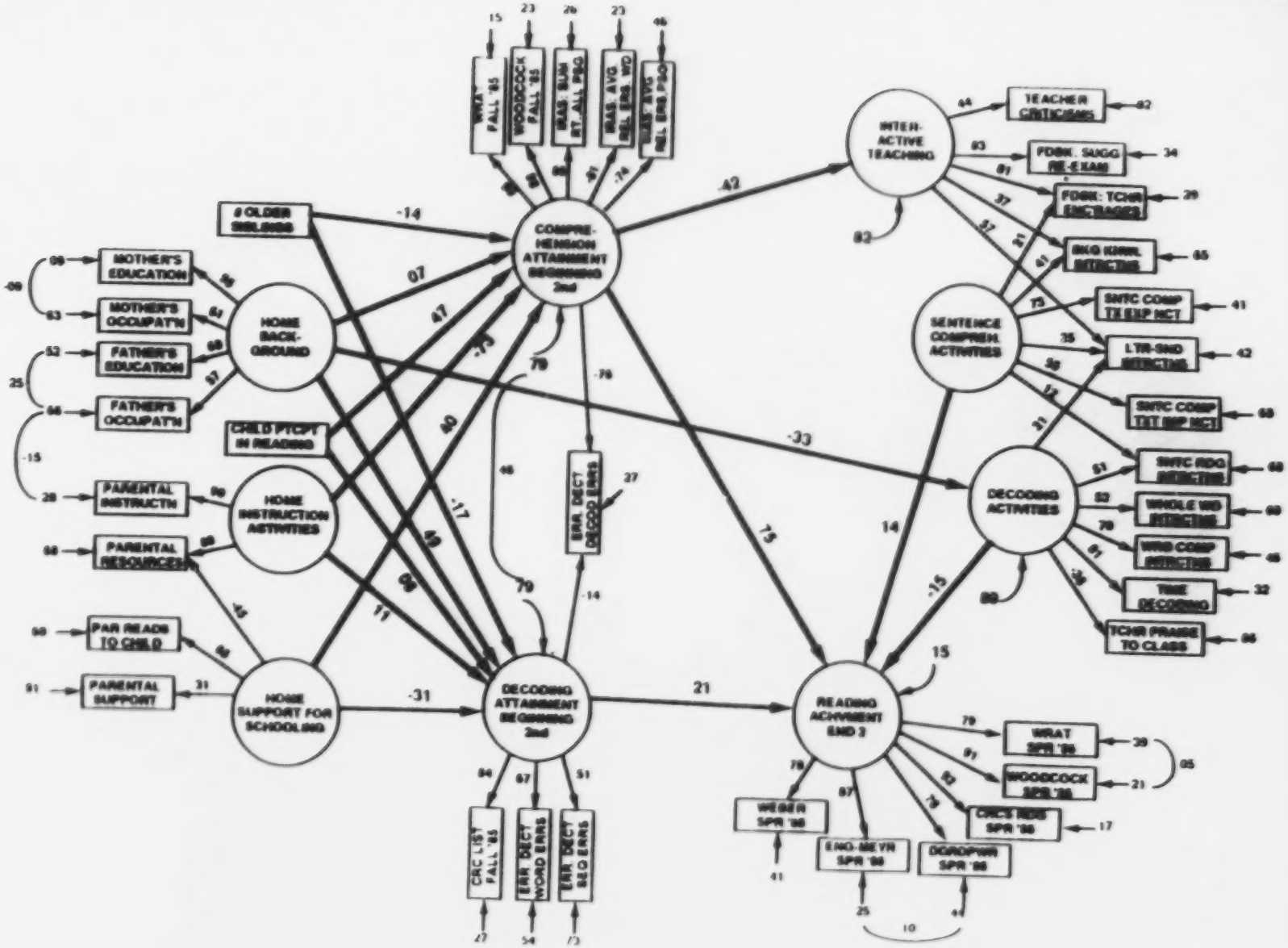


Figure 5. Final Structural Model for Second Grade Reading